THE

ELECTRICAL REVIEW.

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1922 AND AFTER.

To write about the past year is no very pleasant task; the shadow of the war, though lessening in gloom, has hung over us, and the evil effects of that upheaval are still acutely felt. But there are some bright spots in the landscape, and it must be admitted that things might have been much worse. Towards the end of the year, indeed, the case for optimism distinctly improved; on all hands greater confidence in the future is expressed, and there is a general feeling that the prospects are brightening. Progress is slow, but all the more sure; the demand for steel is strengthening, and blast-furnaces that have long been idle are being blown in again; even shipbuilding, which has passed through a period of unexampled depression, is reviving, and the official statistics show a welcome reduction of unemployment. The recent change of Government has undoubtedly exercised material influence in the direction of stability and tranquillity, conditions which are essential to the free play of commercial enterprise, and the national credit, thanks largely to the integrity of our financial policy, stands higher than for many years—the sovereign is approaching par value in the United States. Moreover, the new Government has shown its determination to take positive measures for the reduction of unemployment by the initiation of important undertakings of a remunerative nature—far better to spend money in this way than on the dole, which is not merely unproductive, but is actually a most demoralising method of coping with unemployment.

Railway electrification has been much to the fore, but has not made much material progress in this country during the past year; however, the London Underground railway extensions were begun in June, the Brighton Railway Company placed some important contracts, and the electrical service of the L. & N.W. Railway between Euston and Watford was opened in July. The South-Eastern Railway electrification scheme was definitely taken in hand, and very important developments on other lines are undoubtedly pending, which we hope will materially increase the activity of British electrical manufacturers in the current year. Moreover, valuable orders for railway material were received from Japan, Spain, New Zealand, and South Africa, which are already in course of execution. We look forward to great developments in this class of work in the near future, both at home and abroad; the wide range of apparatus and materials involved—power stations, transmission lines and cables, permanent-way equipment, and rolling stock—ensures the distribution of the resulting benefits over many branches of the electrical industry, and the great magnitude of such undertakings guarantees that the effects of these contracts, involving an outlay of some £14,000,000, will endure for a long period, and will be felt indirectly in many industries.

A notable feature of the electricity supply industry has been the completion of a number of important extensions of generating stations during recent months; in some cases, thanks to the increased facilities for supply, these will lead to a stimulated demand for motors, wiring, and accessories, which may be further helped by reductions in the price of energy consequent upon the economies due to the use of more efficient plant. Several very large stations are in course of construction; the Nechells plant of the Birmingham Corporation is practically complete, and the Barton station of Manchester Corporation is well on the way to completion, whilst those at Portobello, Nottingham, Preston, and Barking are more or less in embryo. Some ten millions sterling will be expended on these undertakings. Mention may be made of the extensions at Stoke-on-Trent, Mansfield.

West Ham, Derby, Hastings, Leicester, Liverpool, and Walsall, of which descriptions have appeared in our pages. We may also refer to the starting of the huge hydro-electric sets at Queenston, Ontario, the largest in the world, and the opening of the super-station at Gennevilliers, near Paris; the latter was the leading feature of the tour organised by the ELECTRICAL REVIEW in October, in which some 70 British engineers took part, visiting the great undertaking of the Union d'Electricité and other systems in the neighbourhood of Paris and the North of France, with much pleasure and profit.

The steady fall in the prices of electrical energy in many parts of the country, which has been one of the most welcome indications of the return of normal conditions, has gone far towards restoring the demand for electrical apparatus for both domestic and industrial purposes, and the reduction in the cost of wiring due to lowered wages and prices has somewhat improved the prospects of the contractor—but there is still much to be desired. There is no doubt, however, that the continued insistence on the necessity of developing the domestic load, so efficiently maintained by the I.M.E.A. and the E.D.A., is bearing good fruit; the public is distinctly awakening to the advantages of electrical methods, and some classes of domestic appliance-makers have been kept very well occupied. The examples set at such places as Hackney, St. Marylebone, St. Pancras, Leicester, Glasgow, &c., of lowering prices and hiring out or lending electrical apparatus are worthy of emulation elsewhere.

Amongst the notable events of the year should be mentioned the Jubilee Commemoration meetings of the Institution of Electrical Engineers, the Jubilee celebration of the Eastern Telegraph Companies, the formation of a Joint Engineering Council, the calling of an International Conference on Interstate Telephony, the initiation of broadcast radio-telephony in this country, and the passing of the Electricity (Supply) Act, 1922.

The great reduction in the cost of electrical plant has done much to stimulate new construction. The Walsall power station, for instance, cost less than £14 per kilowatt—little more than a third of what it would have cost a few years ago. Add to this the improved facilities for progress resulting from the passage of the Electricity (Supply) Act of 1922, and it will be seen that there is good reason to anticipate a large volume of business from home sources during the new year, together with export trade due to the lower tenders that can now be made, enabling our manufacturers to compete with their foreign rivals on favourable terms.

While we feel justified in taking a most hopeful view of the prospects for the electrical industry during the coming year, and are confident that the world trade situation will continue the improvement that has recently been noted, especially if anything like settlement of the Reparations and Turkish questions can be reached at an early date, we are afraid that we must expect some further unsatisfactory returns of industrial companies which during the past year have been battling with many difficulties. It is impossible for them to recover in a short space of time the ground lost during the engineering lock-out, or hurriedly to readjust finances to meet changing values of stocks, or to make large profits when the works are running only part-time. But there are grounds for confidence for the future, and the fact that the electrical industry has been able to "keep its end up" so well amid so many adverse conditions forms one of those grounds. Confidence is one of the great things needed now, as always, when there is a slump in trade, to set the wheels merrily running again. May the end of 1923 see the fulfilment of all the hopes that the opening year seems to justify.

A Year's Losses.

THE death of Sir John Gavey, at the ripe age of eighty years, which it is our sad duty to announce in this issue, reminds us that during the year 1922 a number of men who occupied positions of prominence amongst us in years gone by have passed to the Beyond. Such familiar names as J. J. Easton, R. E. Graves, Dr. Edward Hopkinson, Dr. J. T. Merz, G. G. Ward, Sir John Benn, B. S. Broadhurst, F. E. Hesse, Dr. Gisbert Kapp, H. W. Miller, Sir A. K. Rollit, and Sir R. Vassar Smith all carry with them suggestions of various specialised departments of activity in which the men who bore them performed a leading part in this country, while the death of Graham Bell, of telephone fame, was a world loss, and the disappearance of Dr. Walther Rathenau by a murderer's act removed from the stage one who seemed to be destined to do much to put Germany upon her feet as well as to organise her electrical and other industries for future expansion.

The Imperial Trade Conference.

WE note with satisfaction that Sir William Joynson Hicks is making good progress with his inquiry into the criticisms of the management and policy of the British Empire Exhibition. The report, no doubt, will be forthcoming in a very short time. The sooner the matter lies at rest the better, so that nobody need be in any doubt about the existence of the completest cordiality throughout the Empire in regard to this event. Almost any sacrifice is justifiable if made with that end in view.

We cannot help regretting that the holding of this Exhibition in 1924 and the proposal for an Imperial Trade Conference this year are being coupled together. Of course, one of the great results which we all expect to follow the holding of the Exhibition is a close trade relationship with many accompanying trade transactions. It will demonstrate, among other things, the productive ability of British electrical and allied engineering industries. The objects sought by the Imperial Trade Conference are similar, but schemes and matters of policy rather than demonstrations of British capacity and enterprise, will form its programme. The appeal by a Montreal newspaper writer that the Conference should be deferred until 1924 so that it can be held while the Exhibition is in progress does not commend itself to us unless measures can be immediately adopted, without conference, which shall speedily encourage increased trade between the Home Country and the Empire overseas so as to give our population employment either here or there. We are afraid that if the conference is postponed we shall have renewed apathy in regard to the whole subject. And additional trade, with work and employment for the British race, is wanted at once.

We would throw out the suggestion here that when the Conference does take place His Majesty's Trade Commissioners should be called home for a brief period so that at the gatherings good use may be made of their special practical and up-to-date experience.

Bad Shop Lighting.

IT takes us back to the days of our youth to recall the enthusiasm with which we used to regard the calling of that "mixte" individual whom we described as an illuminating engineer. So many large buildings in the City of London and the West End formed glaring examples of how not to light interiors that we welcomed the coming of the man who, as one of his duties, would enlighten the consumer regarding the uneconomical, inefficient, and ugly work for which somebody had been responsible, and induce him to make a change. Things are better to-day on the whole, but some bad spots remain and new mistakes are being committed in many directions. These were somewhat painfully in evidence during the recent Christmas shopping weeks. Some over-enterprising shopkeepers (especially in the suburbs), in their desire to out-shine their neighbours and command attention, either on their own initiative or at the instigation of their electrical advisers, made too many points, or used lamps of too high candle power, failing to shade them in such a way as to protect the would-be purchaser's eye from the direct rays.

We are referring especially to the interior lighting of shop windows and to the indiscriminate scattering of brilliant lights amongst a collection of glass and silver ware, fancy goods, apparently without a thought having

been given to the comfort of the public. It is largely—perhaps entirely in some cases—a matter of shading; there is a prodigality of points and energy consumption, while a trifle is being saved on the cost of suitable shades. We speak from experience, which many of our readers must have shared with us, when we say that it has sometimes been impossible to see the goods for the glare, and the painful effect of the latter on the eyes has compelled us to pass on to windows where the light was not dull but discreetly and pleasingly subdued. One might think that shopkeepers needed a course of education in electrical illumination as an aid to sales were not the folly of the defect named so obvious.

Heavy Taxation and Industry.

The Premier stated in Paris on Tuesday that he was personally convinced that the heavy taxation imposed upon British people had intensified the great mass of unemployment brought about by the war, because manufacturers and others had been unable to use the money to develop their businesses. Other countries suffered war devastation of other kinds. This is our war devastation, and it is still with us.

He went on to say that we had made our Budgets strong by impoverishing the taxpayers, but as we lived by our foreign trade, unless the trade of the world was to develop normally, we should find ourselves in a more critical position than many of the Allied countries which are in a far worse financial position than we are at the moment. All of this was said to justify the British demand for reparations from Germany up to the limit of her capacity to pay. That consideration apart, however, it is obvious that the Premier recognises how detrimental the present high taxation is to our industries, and that he will not be a party to its continuance, when lightening of the burden is possible. May that be soon!

The Exhibition.

It is very satisfactory to learn, as we do at the moment of going to press, that in view of the large demand for space, particularly for the engineering and electrical exhibits, it has been found necessary to recommend the extension of the Machinery Hall plans for the British Empire Exhibition at Wembley, by the addition of 70,000 sq. ft. of space, in order to house the entire sea and land transport group of exhibits in the extension. This group will include railway and tramway rolling stock and material, motor cars, road material and sea transport. The Machinery Hall, when extended, and the already extended Industrial Hall, which originally occupied a combined area of 800,000 sq. ft., will cover 889,415 sq. ft. The two halls will stand opposite to each other, east and west of the Grand Avenue, and should form a very creditable demonstration of the greatness of these national industries. Everything points to the display being really great—such as British industry has never before been able to bring together—an occasion which will convince the world of many things.

Honours.

We suppose that science and engineering have as much cause as any departments of professional or industrial activity for satisfaction at the prospect of something being done to ensure that the lists of Honours issued in the name of His Majesty shall in the future be less open to suspicion, and those who are responsible for the selection of subjects for special distinction be less liable to the charge of injustice, favouritism, inability to recognise sterling merit and service to the nation, susceptibility to wire-pulling, and so forth. Few things can lower our national prestige and lessen the confidence of the people in their governors more than a cheapening of honours by granting them as the result of political bargains, for money, or other payments, or for persistent importunity. This Government should certainly be able to effect at any rate some degree of improvement without imperilling its Peace and Tranquillity policy. In the incomplete New Year Honours List which has appeared this week, there is only one name coming immediately within the scope of this Review, and it has been felt for a long while that the public services rendered by Mr. Edward Manville, M.I.E.E., have well earned for him the distinction of knighthood that has now been conferred upon him. A sign that the honour has been more or less taken for granted lies in the fact that it has sometimes been necessary to turn up the reference books to check the errors of newspapers which in "intelligent anticipation" as usual, have described him as Sir Edward.

London's Electricity Supply.

The first thought which recurs to the reader of the L.C.C. report upon London's electricity supply during 1920-21, is that if unification and reorganisation are required anywhere it is in the London area. Nowhere else could be found such duplication of effort and such a variety of methods, systems, and prices. The last item is particularly of interest to the consumer, although it depends upon the other two to a great extent. All the explanations possible will not pacify a consumer who pays 1s. per kWh when he finds that in a district very close to his own less than half this price is being charged, and such disparity militates against the extended use of electricity in the districts where expansion is most needed. This can only be brought about by the elimination of small and unprofitable stations, the co-ordination of control, and a uniform system of supply. This must, however, come gradually, and in the meantime all efforts must be directed to the lowering of costs by economy and improved efficiency. It is our fervent hope that the New Year will see further substantial progress in the desired direction, and we confidently anticipate that the good offices of the Electricity Commissioners will assist in this.

The Work of the Commissioners.

The second annual report of the Electricity Commissioners, of which an abstract is begun in this issue, again bears witness to the accomplishment of a great volume of work, in spite of the depression in trade and the handicap under which they laboured due to the delay in providing them with the statutory powers indispensable to their full activity. The report relates to the year ending last March, and therefore no reference (except in a footnote) is made to the removal of that handicap by the enactment of the Electricity (Supply) Act, 1922. In passing, we may suggest that a lapse of nine months between the end of the year and the issue of the report greatly detracts from the interest attaching to the latter; we know that the Commissioners are extremely busy men, but busy men have to select the most urgent matters for first attention. Public opinion is one of these, and we think the Commissioners would be well advised in publishing the results of their year's work at an earlier date.

As usual, the reorganisation of electricity supply has occupied a large amount of their time; schemes for 12 of the 15 districts have been considered, and the Commissioners' conclusions have been published in respect of five of them, but progress in giving effect to the schemes has been slow, partly due to the deficiencies of the Act of 1919, which have now been made good. It is clear from the report that an extraordinary amount of discussion and negotiation is necessary, before acceptable decisions can be formulated.

No fewer than 394 applications for sanctions to loans were received during the year from local authorities, and sanctions were issued in 389 cases; the total amount sanctioned during the year was £13,650,033, which sum is 1½ millions less than in 1920-1, but probably represents a greater amount of new construction, in view of the lower costs prevailing in the later period.

The total output of British generating stations during the year is recorded as 4,884,666,038 kWh generated, the consumption of fuel being 6,475,531 tons of coal and coke, and 145,541 tons of oil. Returns were received from 433 stations belonging to authorised undertakers, and 103 traction or non-statutory undertakers' stations.

THE THEFT OF ELECTRICITY AND ITS PREVENTION.

By J. A. REYNOLDS.

In all probability no public service company suffers more severely from theft than an electricity supply company, for it is a lamentable fact that theft of all kinds varies directly with the ease with which it can be accomplished, and it is immediately obvious that it is easier to steal electricity than, for instance, water or gas. Theft of any kind also varies inversely with the honesty of the community involved, but this is only relative, and the former consideration is by far the most important factor in the case.

That all public service organisations suffer more or less severely from frauds of various kinds is also unfortunately true, and for some rather obscure reason otherwise upright persons consider themselves clever rather than dishonest when they succeed in cheating such an organisation out of its rightful gains.

The conclusion to be drawn from the above is that when it is possible to steal and easy to steal, an enormous amount of theft will occur.

In the older and more highly civilised communities, not only is the standard of honesty higher, but, in pursuance of "good practice," electric light companies, for instance, automatically protect themselves by adopting standard arrangements, which have been originally developed with such protection in view. In such a country, however, as the writer is stationed in, matters are very different; not only is the standard of honesty low (extremely so where public service companies are concerned), but, furthermore, the companies themselves are very much inclined to adopt much cheaper methods, and the small consumer, who is not only in the vast majority, but is also the worst offender, is unintentionally given considerable facility to do what he is only too anxious to do, that is to say—steal.

As comparative statistics have shown that a large potential revenue is lost by the use of the "flat rate" system, even when controlled by a current-limiting device, the tendency to adopt the metering system is greatly on the increase, and, above four or five lights, it is becoming customary, at least with the larger and wealthier companies, to install meters, which can now be obtained at a remarkably low figure, when purchased in quantities. This the small consumer has deeply resented, and considerable ingenuity has been expended in devising means to prevent the proper functioning of these "objectionable instruments." As already stated, however, this is only too easy in the majority of cases, and it is an established fact that a very large revenue is lost yearly to the electric light companies through theft of electricity.

There are many ways by which the proper operation of the meter may be prevented, and these may be divided into two main classes, *viz.*, mechanical and electrical. Regarding the first, the use of glass covers and something superior to the ordinary lead seal will go far towards preventing fraud, and there is more than one "unbeatable" seal on the market.

As all electrical tampering absolutely depends upon gaining access to some part of the circuit on the supply company's side of the installation, the remedy is obviously to make such access impossible, and this can be done, and is done, by means of a complete conduit installation from the meter terminals to the supply wires or cable. This is a very expensive means of protection, both in material and labour, and companies are very disinclined to go to this great expense, not only in the case of new installations, but more especially where it is found desirable to protect a large number of old ones.

In the case of single-phase meters used on the almost universal three-phase four-wire system, a very simple device is available, which is not only very much cheaper than a conduit installation both in material and labour, but is more effective as well.

To protect meters installed on such a system, three things are necessary, *viz.*:—

(1) Access must be prevented to what will in future be designated as the "current" wire, to distinguish it from the "earth" wire.

(2) Complete protection must be given to the terminal board of the meter on the company's side.

(3) Reversal of the incoming leads must be made impossible.

The last is as necessary as the other two, as it is generally possible to reverse the leads at some point on the company's side, remove the fuse on the former current wire, and make an artificial earth at some part of the interior installation. When this is done the meter will, of course, cease to function, but if the artificial earth is a good one, full service can be obtained.

The above objects are attained by the use of the following simple combination, as shown in the drawings. As it is manifestly unnecessary to show the application of the combination to all classes of measuring or controlling instruments (such as current-limiting devices, maximum-demand meters, time clocks, or any like instrument), the ordinary single-phase watt-hour meter has been chosen to demonstrate the method, as the terminal boards of all other instruments are necessarily somewhat similar.

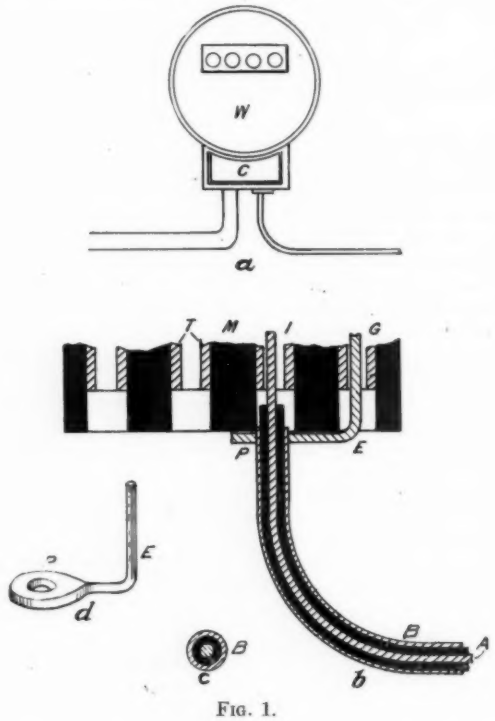

FIG. 1.

The connection between the supply company's wires or cable and the meter is made by a piece of concentric cable which (see fig. 1*b*) consists of an inner insulated conductor A surrounded by an outer cylindrical conductor B, which may or may not be braided. The outer conductor consists of a double wrapping of copper tape, having the same conductance as the inner or "current" wire. The outer conductor is connected to the earth wire of the system by binding it thereto, and the inner conductor is connected to the phase wire in the usual way.

In fig. 1*a* the cable is shown entering the instrument w at the right, and the two wires leaving the instrument

and leading to the consumer's installation are seen on the left. The terminal board of the instrument is under the sealed cover C. The exact form of this board is not of importance; a very simple form has been chosen for the sake of simplicity. The terminals, which consist of tubes fitted with screws for holding the wires, are shown at T in fig. 1*b*, the insulating material separating them being indicated at M in the same figure.

The connection at this terminal board is made as follows:—If an outer braiding is furnished, this is removed for the requisite distance, and a small plate-like piece of metal P (see figs. 1*b* and 1*d*) having an extension E, is slipped over the outer conductor and soldered, or otherwise attached, to it. The outer conductor is then stripped down to this point and clipped off, leaving the inner insulated conductor projecting above the plate. Sufficient dielectric is now removed, so that when the wire is in position in its terminal, the plate portion of the piece will be in close contact with the insulated bushing of the current wire entrance. Before fixing the wire in its terminal, the extension E is bent up so as properly to enter the earth terminal as shown in the figures. Both connections are now pushed up into their respective terminals and securely clamped in position by the binding screws, thus holding the plate firmly in place. In practice the operation is simple and rapid.

The outer conductor, or sheath, should be well earthed at some point, and if the meter itself is not earthed (as it should be) the sheath must be earthed elsewhere. It is preferable to have the outer conductor covered at least with a braiding to protect the metal, but this can easily be removed at some point and the metal earthed. Clearly the better the earth the more effectively will the reversal of the leads be prevented.

As previously stated, three things were necessary to prevent theft of current, and these three objects have been attained. In the first place, access to the interior or "current" wire is impossible, at least without instant detection. In the second, no pin or wire can possibly be pushed up into the current terminal, as the plate completely and closely covers it; and thirdly, reversal of the leads outside will result in a dead earth.

The method described applies particularly to two-wire installations, but it will be readily seen that as long as two-wire instruments are used it can be extended to supply systems of any number of wires or phases. As an instance of this, it may be mentioned that as three single-phase meters cost considerably less than one polyphase meter, it is preferable to install three of the former in place of one of the latter. In such a case complete protection will be obtained by using three of the concentric cables and terminal pieces as described above.

It will be readily seen that the cost of the concentric cable installation compares very favourably indeed with that of the conduit installation. For the former nothing is required beyond the following:—Length of cable necessary; terminal protection piece; three or four inexpensive clips for attaching the cable to the wall; and the necessary material for soldering the connections. Both plate and cable are manufactured by the licensees, Messrs. W. T. Henley's Telegraph Works Co., Ltd.

For the conduit installations the following material is required:—A special connection box at the meter; the necessary length of conduit; at least one elbow; bushings and other fittings; rubber-covered wire, at least for the current wire; clips for attaching the conduit to the wall; and the necessary material for soldering two connections.

As regards labour, it is obvious that the conduit installation will in all probability require a rather higher class of labour, and, in addition, considering the threading, bending, and fitting, will occupy very much more time even for the shortest and straightest runs. When the run is more tortuous, the superior economy of the concentric cable is even more apparent. Furthermore, when using the concentric cable, no special tools are required and no heavy material has to be carried about. This is not the case with the conduit installation, as not only are special tools required, but the material itself is heavy and awkward to transport.

THE ELECTRIC SYSTEM FOR SMALL WATER-POWERS.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E.

SMALL water-power plants were in operation long before steam power was considered possible. In the early days of water-power development it was necessary, in order that the industries might utilise the water power available, to group them close together where a head race could be favourably constructed, and generally this took the form of a huddled mass of factory buildings jammed in together as closely as they could be constructed, and the whole works dotted about with shaftings, &c. This class of power afterwards became outgrown, and, when the more economical method of producing power came about in the use of steam power, it was supplemented with *auxiliary* steam plant, which kept growing and improving until the water-power plant was generally used as the auxiliary plant. Then followed perhaps the most remarkable period in the history of power development, a period in which it was shown that power could be generated in one place and transmitted and delivered at high efficiency (over copper wires on insulated circuits) several miles away.

At the present time the working of small water-power schemes can be classified under three main headings, namely:—

(1) Those commonly known as mill sites, which often are hydro-mechanical (even at this stage of the art) and fed from open flumes or from a forebay, but no penstocks, where the mill, factory, or works is built over the river or forms part of the hydraulic structural works.

(2) Those schemes where the hydro-electric machinery and equipment depends upon regular attendance for control and supervision, such as starting and stopping, and the usual operation. For these schemes any class of electric system may be employed, such as d.c. or a.c.

(3) Those schemes where the hydro-electric plant is operated and controlled automatically from one or more distant points, and, as can be done in the case of (2), in order to make the best use of the waterpower available, they are operated in conjunction with other water-power plants and/or fuel plants (steam, gas, or oil). But these schemes are cheaper than (2) because of the lower cost of supervision and lower cost of plant, switchgear, busbars, cables, wires, &c., all of which generally decide whether a scheme is commercially good or is worth developing or not. Moreover, the generators are more robust and much simpler and the power-house in general is simpler and safer. For these schemes (preferably taken in group, but not necessarily so), there is one type of electric system, namely, the a.c. induction-generator system controlled from a suitable point or points as shown diagrammatically in figs. 1, 2, and 3.

Definitely setting class (1) aside, there is a choice of two schemes, namely (2) the d.c. or the a.c. synchronous generator system, and (3) the induction generator system (preferably three-phase) automatically controlled.

In this, as in every system conveying energy, two fundamental economic questions arise, the best system being that which best satisfies Kelvin's law wherein the total net annual income shall be a maximum or the percentage return on the investment shall be a maximum. Indirectly, this law should ordinarily include security of service, *i.e.*, quality of materials, workmanship, &c. This point, like many more, can be discussed from different angles. In fact, one of the first questions to be asked would be that of relative reliability of the two systems. In some respects each scheme must be taken on its own merits as to general conditions and as regards quality or grade of and conscientiousness of technical help and superintendence, which varies greatly. The best that can be done is to put in the best plant, simple and robust in construction, and requiring the least attention; the proposed system seems to accomplish all these in the best way.

The relative advantages of system (2) over system (3) will depend on whether there is one water-power plant or a number of plants or possible schemes capable of development within a reasonable area, and therefore the first installation should be chosen with great care and with this end in view with respect to systems in the vicinity. Each water-power scheme, or group of schemes, whether on the same or on different catchment areas (within reasonable distance from each other) must be judged on respective merits, local conditions, relative distance from each other, from the load, and from a fuel plant, and be chosen according to the existing class of electric system and supply (d.c. or a.c., phase, voltage, frequency, &c.), and according to the relative magnitude of available water power, kind and character of load, also with a view to the advantage of diversity by tieing-in plants (see fig. 3) with flow from watersheds of different characteristics and other considerations. In general, the writer believes the advantages would come out in the following order:—

(*a*) The development of the *smaller* water-power schemes can better be made possible (but more often made possible *only*) by one-unit induction-generator stations automatically operated from a suitable distant point; or by self-synchronising synchronous generating stations operated automatically from a distant point.

(*b*) The development of the larger water-power schemes (coming under the class of small water powers) can be made commercially the best by automatic operation of *several* water-power plants from a suitable control point as shown in figs. 1, 2, and 3.

(*c*) For a *single* development of the larger water powers (coming under the class of small water powers), the system to install will depend largely on local conditions, distance from village or town, distance from load and from other sources of power, the existing system or systems in the vicinity, character of load, power factor, whether ample exciting current is already available, and other considerations, such as speed of turbine and/or induction generators, their frequency, voltage, and the distance from the source of exciting current or cost of providing an ample supply.

Granting that the total capital cost (which includes operation) is much less for (3) than for (2), there still remains the question of relative quality of and reliability of power supply. Many years have gone by since the writer last operated this type of plant*, and, like most early experiences, his memory is clear as to the construction, operation, and behaviour of the induction generator on a power transmission system. In those days the question of operation was slightly different to that proposed herein, but the difference was not due to any lack of knowledge of remote control or automatic operation; in fact, the present question is an economic one, the technical problem varying but little, if at all, from that of old.

A comparatively large water-power scheme of the early days would now be classified as a small water power. Industrial expansion, coupled with the keen economic necessity existing at present (a condition that is liable to be more acute with advancing years), may in many cases force the development of certain groups of small water powers now known to exist. With one-unit hydro-electric stations the problem is simplified, and there is a choice of several different systems and different methods of operation. With a group or several hydro-electric stations there seems but one reasonably good or possible commercial system. The system proposed is that of automatic operation of stations where the *total* developed hydro-electric power from each river or stream is transmitted to and controlled from a suitable distributing point, just the same as if the respective stations were in separate compartments of one building isolated from each other, and the control board was in a different compartment of the same building. To accomplish this in perhaps the most economical manner, the induction-generator system (3) is proposed, and the manner of doing this is shown diagrammatically in figs. 1, 2, and 3. Of course, we may install synchronous generators and make them self-synchronising by means of damping windings, &c.

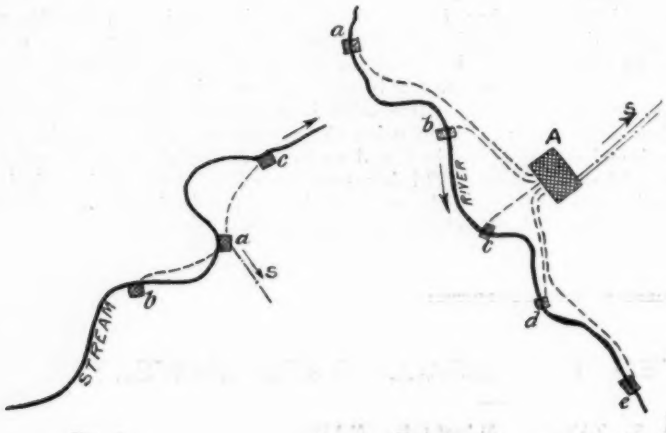

FIG. 1.

(a) Hydro-electric station, which contains a synchronous machine and induction generators. (*b*) and (*c*) Induction generator stations controlled from (*a*) station.

FIG. 2.

(A) Steam-electric station with synchronous generators (control station for all the induction-generator hydro-electric stations). (*a*) to (*e*) Induction-generator hydro-electric stations.

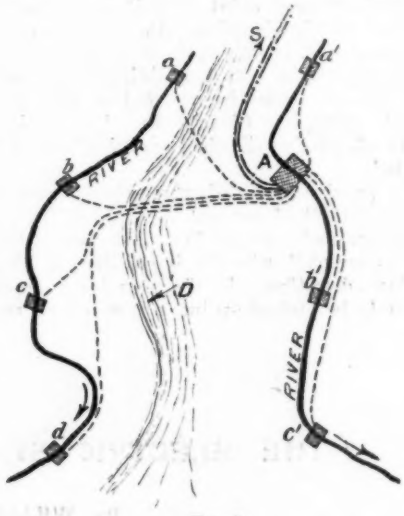

FIG. 3.

(A) Control hydro-electric station, with mixed generators (induction and synchronous). (*a*) to (*d*) and (a^1) to (c^1) Induction generator stations controlled from (A) station. (D) Ridge dividing the two catchment areas. (S) Main supply lines to the receiving stations. — — — Lines from induction stations to the control station.

* In 1904, California, U.S.A.

Without going into any great detail and without showing the merits and demerits of various systems, the following points are brought out to show what advantage the choice of system (3) has for this class of water-power development, which is vastly more numerous in this country than big water-powers:—

A. Cost of generating station, machinery, and equipment is less.

B. Cost of operation and maintenance is less.

C. Much simpler generati g station.

D. More robust and safer generators, as they are more substantial in construction.

E. Depreciation is less rapid, due to robust and simpler construction.

F. Less liability to breakdown and burn-outs.

G. In a one-unit station (which would be the general rule) the only circuit is that from the generator to the switchboard, and then to the line.

H. There is no collector ring or commutator.

I. There is no exciter and no exciter circuit.

J. There are no exciter switches, busbars, nor exciter wiring.

K. Voltage is generated on the stationary armature.

L. Revolving part is a robust, solid structure of iron and copper bars.

M. Generator is safer; this also applying to the station.

N. Generator requires no attention; this also applying to the station.

O. Generators do not require synchronising apparatus of any sort.

P. Generators adjust their own phase relations on being switched together. With a one-unit station in particular, there is no real necessity for governors—in such cases the turbines are designed to give a safe runaway speed, say, about 70 per cent. above normal. Also, the turbine capacity is so rated that the generator cannot become very much overloaded.

Q. Reduction in the magnitude of surges. In fact, without excitation the induction generator cannot supply power, voltage, or current. Hence, there is always less danger, or a total absence of danger, from heavy current rushes on short circuit such as would occur on the ordinary system.

R. If the circuit-breakers open, the fuses blow, or the circuit is opened in any way, the voltage dies away.

S. For a given frequency and terminal voltage the current depends upon the power supplied by the turbine. On the other hand, the frequency of the system is determined by the currents supplied by the synchronous machine (synchronous generator or/and rotary converter); thus there is no necessity for the induction generators to run in synchronism.

T. For a given load the induction generator has a definite speed above synchronism. Ordinarily, the frequency will not change so long as governor-controlled synchronous machines are operated on the system.

U. The generating sets may be automatically started and stopped by remote control, depending on the flow of the river, or they may be started and kept running, &c.

V. In general, the best method of operation will be to drive them without governors, so that their output will be kept constant and the load fluctuation will be taken care of by the synchronous machine. If governors are installed, the initial cost is increased, and, with governor-controlled turbines, the speed of the induction generator will drop slightly with the load. Therefore, in order to divide the load properly, it will be necessary for the speed of the synchronous machine to drop if speed adjustment of the induction generator cannot be automatically and satisfactorily controlled at a distance, but this is not likely, as the governors can be adjusted. Without governor-control the induction generators will absorb whatever power is available, speeding up until they slip above synchronism sufficiently to transfer the generated power to the control station, which is the most desirable condition at all times.

W. The only safety device (neglecting atmospheric disturbances) would be fuses to cut off the set or station in case of accident, which would rarely be possible with low-voltage induction generators.

In the early days there was no station automatically controlled from a distant point. To run any induction-generator station, some means of excitation must first be provided. Going back 20 or more years we find that several means for excitation were proposed, and that the most promising one since then, and up to the present time, has been that of operating the induction generators upon the same circuit as synchronous generators or rotaries which, under these conditions, automatically adjust their phase relations, this action continuing within limits, with variation of the magnitude of power factor of the load. In starting up an induction-generator plant, the water is let in and the turbo-generator brought up to about synchronous speed, then the generator is switched in. In the early days this was done through reactance coils to reduce the current rush. After switching in, more water is admitted to the turbine, and the load is divided in this way. In operation, when additional load comes on the system, it first comes on the synchronous machine, and then, as this machine slows down and allows the slip of the induction generator to increase, part of the load is transferred to the latter—the synchronous machine supplying simply the additional lagging current required by the generator when carrying the additional load. Up to the present time one practice has been to allow the synchronous machine to supply at all times all the lagging wattless current in the circuit and, with governor control, the governor on the turbine driving the induction generator would help to stabilise the frequency, the synchronous machine slipping behind the induction generator an amount just sufficient to allow the latter to supply all the power required by the circuit. The frequency of the system will depend upon the characteristics of the external circuit. Actually the synchronous machine sets the frequency, and the power factor of the *total* load is adjusted by the synchronous machine to properly care for the power factor of the induction generators. These machines may have the power factor improved by the installation of electrostatic condensers. Condensers are desirable, but besides condensers, a synchronous machine or rotary converter is required. With governor-control the load can be transferred from one induction generator to the other by means of the governor on each turbine, and in this way the load can be distributed at will among the sets without any adjustment of the excitation, so necessary with the common system of to-day. In some cases it may be better to install synchronous generators and to make them self-synchronising than to attempt to improve the circuit conditions by adding condensers or any other type of phase compensators.

In the early days induction-generator installations were of the polyphase type due to the common system then in use, and therefore little or no difficulty was encountered in obtaining the most desirable requirements, such as speed, voltage, and ample reliable excitation; the latter was derived from the same station or/and from one or more distant sub-stations in the form of rotary converters, which were usually of the 60-cycle type. In the choice of a system for the available small water-powers of to-day (with particular reference to this country), such questions as additional cost for the required amount of exciting current, the amount of available excitation within reasonable distance, the turbine and generator speed, frequency, existing systems, load power factor, &c., will perhaps be more important than the relative advantage of initial total cost in favour of the system proposed herein for group operation of plants. The best requirements call for three-phase supply excited from either rotary-converter* or synchronous-generator stations—steam, gas, oil, or water-driven. A large number

* Whereby adjustment of field excitation for the proper d.c. voltage would fix the a.c. voltage.

of stations in this country can supply d.c. or/and a.c. (single-phase) current. In view of the fact that the induction generator is more suitable to high-speed work and that schemes will usually be of the very low-head class, there is likely to exist the disadvantage of low speed of turbine with the expense of turbine speed gear. Perhaps the two weakest points are low power factor (the induction generator being more suitable to high power factor) and distant voltage regulation, *i.e.*, control of excitation from a distant point. The former, with its wattless current, is a disadvantage at any time, but more so here, because the induction generator is unable to supply a magnetising current, and it requires lagging current for magnetisation, which necessitates a larger rotary converter or synchronous machine than would otherwise be required to supply the wattless current necessary for the induction generators as well as the load. As regards the question of operation, if the excitation is cut off entirely, the plant affected is shut down, but with relatively much less disturbance to the system; however, a shut-down would occur in any case, with any system, for an open circuit or a short-circuited line, hence there is no disadvantage here, only that voltage regulation might not relatively be so good as when controlled from the same station. This point is a question of efficiency of operation and is controllable. Nevertheless, to approach fairly well the efficiency of the ordinary synchronous generator, it is desirable that the induction generator shall have high speed, low frequency, and low voltage. With the installation of the self-synchronising synchronous generator, certain points are immediately eliminated from the list of demerits.

Ordinarily, we are in the habit of thinking that regulation of the voltage should be done at the generating station only. Generally there is a voltage drop along the line from the generating end in the direction of the load end or receiving station, and, generally, the voltage at the latter point must be kept at an approximately fixed value independent of the voltage at the generating end. This being so, for every system in operation to-day,* is it not evident that the operator at the receiving station (or at the control station in the proposed system) is the best person, provided he were able to do so, to control, to regulate, and to fix the voltage at his—the load—end† of the system? Oftentimes it would be desirable for the central-station operator to be relieved from certain duties, but rarely the operator at the receiving station. In the proposed system the voltage is controlled at the central control station, which is the point of control for one or a group of automatically-operated hydro-electric plants. As pointed out in the last paragraph, should there be a short circuit or a broken line conductor on any of the induction-generator circuits leading from any hydro-electric plant to the control station (see figs. 1, 2, and 3), then that plant affected would be shut down just as if an accident had occurred on a unit in a generating station containing one or several units, with the exception that little or no electrical disturbance would occur in the former case, whereas in the case of a d.c. or a.c. synchronous generator station the rush of current would usually be sufficiently large to cause a surge, but more likely a shut-down or a general interruption of service if the relays, fuses, or circuit-breakers failed to act.

The development and the operation of small water powers follow the same general law of economics as the larger water powers, but there is a limit to the *net* income apart from first cost, or a limit to the minimum percentage return on the investment, which makes it possible or feasible to develop a scheme commercially. It is quite possible that, by means of the system proposed herein (shown diagrammatically in figs. 1, 2, and 3), many of the small water-powers now generally considered as commercially poor or impossible of developing, can be made fairly good or quite good business propositions. If the expense of operating staff for three, four, or more *one-unit* hydro-electric stations can be reduced (compared with present conditions) to 20 per cent. of the total cost of operation by adopting the system proposed herein, there is a possibility that more of the small water powers (now considered commercially worthless) will be developed. An assistant from the control station would be required to make periodic inspections, &c., of the automatically-operated hydro-electric plants.

The linking-up of several small water-powers, mentioned herein, is intended to convey the impression that, if desired, a start can be made with one station only, and, as the energy demand grows, more stations can be developed to supply the demand for energy. The greatest benefit will be obtained where stations are operated in conjunction with *large** steam stations. Over the ordinary hydro-electric system the method proposed herein shows decided advantages in several different ways; but one of the most important advantages is in the relatively larger proportion of the water power which can be effectively utilised. This advantage alone may, in some cases, decide in its favour because of the proportionately greater annual saving in fuel costs due to taking the very best possible advantage of seasonal irregularity of stream flow for each and all of the linked-up hydro-electric developments which, singly or jointly, would increase the kW-hour capacity of the power transmission and supply system. The steam plant might be 20 miles or more distant from the control station. The latter may or may not contain step-up and/or step-down transformers; the former will usually be located in or on the outskirts of a town, whereas the latter is more likely to be located in some remote part of the country. The hydro-electric plant (*a*) of fig. 2 might be 20 miles or more distant from the hydro-electric plant (*d*). From a commercial viewpoint, the distance is limited (in the ordinary way) by the amount of power available, but with the proposed method of power control and supply, the location of the control station would indirectly allow an increase in the transmission distance from respective water-power sites and would also in this and in other ways tend to make possible certain water-powers that would otherwise be commercially useless.

For many of the largest and most important high-voltage power transmission systems of to-day, the transformers, h.p. switches, and busbars are located outside the power house—the apparatus operating under remote control. Surely, as this is a recognised good practice, and, as transmission lines are so thoroughly reliable, and as the lines or cables in this case will be very short, and the power plant relatively more robust, simpler, and safer to operate, &c., there seems no reason to suppose that anything unusual can happen with the relatively *miniature* system of water-power developments proposed herein.

Diesel Engine Users' Association.—At the December meeting of the Diesel Engine Users' Association, Mr. A. E. Farrow, A.M.I.E.E., engineer to the Windsor Electrical Installation Co., Ltd., was elected president for the ensuing year, and Mr. Percy Still, M.I.E.E., was re-elected honorary secretary. Messrs. E. W. Johnston, E. Birkett, and J. G. Griffin were elected to fill vacancies on the General Committee. The honorary secretary made a statement concerning the further increase in membership during the year, and gave a summary of the work which had been carried out. The committee had given consideration to the suggestion that the name of the Association should be altered to "The Heavy Oil Engine Users' Association." It was thought that it might be desirable to alter the name, but no definite decision was arrived at.

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* Such systems as these small plants are more likely to be tied-in with...

† The point where it is definitely known what voltage is desired.

* Preferably many times larger in kW capacity.

† Ranging from 10 to 20 per cent. of that of the steam-electric plant when considering the installation from the viewpoint of *induction* generators. Of course, an entirely different aspect is presented in the case of the installation of (*a*) self-synchronising synchronous generators, or (*b*) d.c. series generators. But this text centres on the squirrel-cage type generator.

GERMANY'S DIFFERENTIAL SALE PRICES.

THE Berlin correspondent of a provincial newspaper recently drew attention to the practice which has grown up in the German export trade in the past few years of charging differential sale prices according to the country of destination of the goods and the rate of exchange prevailing as between Germany and the importing countries. He pointed out that under a formal law passed in 1919 the obligation was placed upon German exporters to charge English importers from 50 to 100 per cent. more in marks for goods than they require Russian, Austrian, and other East European importers to pay for the same classes of merchandise, and not to sell to England in German marks, while at the same time permitting the Germans to accept marks from Austrian, Russian, and other East European purchasers.

One of the consequences of this system has been that it has been possible for countries, or small States such as Dantzic and Memel, for instance, to purchase in marks larger quantities of goods than they required for internal consumption, and to re-export the balance as their own products to countries having a high currency, and thus obtain the large profits resulting from such transactions carried out at prices just below the world's market prices. In this way not only has the competition of manufacturers in the purchasing countries, such as Holland and Denmark, been worsted, but the possibility of British manufacturers competing for these orders has been entirely removed.

These evasions of the Treaty of Peace are said to have engaged the attention of the Ambassadors' Conference, although they have been known to have been proceeding for a long time past. The system is carried on under the control of the Foreign Trade Boards for different industries, including two for the iron and steel trades and one for the electrical industry. These boards, which are the official authorities for the grant of export licences, are composed of manufacturers and merchants, and have State officials attached to them; they fix the minimum prices at which export orders may be accepted, and only in exceptional cases has an appeal to be made to the higher authority as represented by the Federal Commissioner for the Import and Export Trade.

By a coincidence, according to German advices of December 8th, the Federal Commissioner is reported to have issued fresh instructions to the Foreign Trade Boards on November 27th, as a result of "guiding lines" approved by the Control Committee of the Economic Parliament in the matter of invoicing export transactions in foreign currency. These guiding lines, which are to be followed by the Trade Boards from the present time, seem considerably to modify the practice which has hitherto been adopted. In the report approved by the Federal Commissioner and transmitted to the boards, the Control Committee expresses the opinion that a State regulation of the obligation to invoice in foreign currency in general cannot be carried out in the long run. So long, however, as for external and currency political reasons, it is not possible to abandon such obligation, the committee considers it right to propose the following guiding lines, which are declared to appear appropriate for taking into account the interests of the export trade as far as possible:—

(1) The Foreign Trade Boards can make the grant of export licences for high-exchange countries dependent upon the invoicing and payment of the exports being effected, according to the choice of the exporter, in the currency of the importing country or in another high-exchange currency. In making the conversion, the prescribed minimum price is to be obtained.

(2) As high-exchange countries are considered: England, Denmark, Sweden, Norway, Holland, Switzerland, France, Luxemburg, Belgium, Spain, Italy, Finland, Czecho-Slovakia, Turkey, the United States, Canada, South and Central America, Japan, China, Persia, and Egypt, as well as the colonies and protectorates of these countries.

(3) In the case of all other countries not included in the preceding list, the invoicing and the payment for the export value in the exchange of the purchasing country is also admissible. Nevertheless, the possibility of the use of a high-exchange currency or gold marks as an internal method of charging is admissible.

(4) In special cases, and in regard to such groups of goods as may be permitted by Germany's capacity, the compulsory regulations concerning invoicing and payment in high exchange or gold marks can be made also for countries not embodied under No. 2. Exceptions to the principle given under No. 3 can be allowed by the Foreign Trade Board competent for the group of goods concerned. If they have not been arrived at unanimously, such decisions are to be placed before the Federal Commissioner for approval.

The low-exchange countries, according to the circular issued to the Trade Boards by the Federal Commissioner, are essentially only the countries in the East and the South-East of Europe. In this connection a German newspaper mentions that the export trade to these low-exchange countries, in so far as the business has been transacted in marks, has brought about a considerable private and national economic loss in recent months, and as a consequence an increasing demand has arisen for a high exchange being adopted in invoicing also to these countries. It is added that as foreign competitors only sell at the world's market prices, there is no occasion for the Germans to quote cheap mark prices to these countries, while the prospect exists of the German goods being re-exported to high-exchange countries.

The fresh instructions to the Trade Boards will, if carried out in practice, do much to minimise the abuses to which reference was made at the beginning. In the meantime it is noteworthy that Great Britain forms only one of a large company comprised in the class of high-exchange countries which are subject to the conditions set forth above.

Telephones in India.—In the matter of telephones India is fast joining the ranks of the progressive Western nations. An extensive scheme for connecting by telephone all the principal cities and commercial centres is being carried out by the Government of India, and when the scheme is completed it will be possible to ring up Kashmir from Cape Comorin, Rangoon from Peshawar, Lhasa from Bombay, and so on. According to the *Westminster Gazette*, the progress of the work depends mainly on financial considerations. In each Province the work is pushed on to the extent of the funds allotted to each by the Indian Government budget year by year. For the distance between Bombay and Calcutta three or four repeater stations will be required. The arrival of a consignment of repeaters on order is being awaited for the opening up of several long-distance systems which are otherwise virtually complete. Numerous trunk lines have already been established. There are trunk lines joining Bombay city, Broach, Surat, and Ahmedabad, and Bombay and Poona. These local trunks will soon be extended into the cotton-growing regions of Nagpur, Dhulia, Akola, Amraoti, and also to Indore.

The Government Telegraph Department's programme of operations involves the establishment of the Bombay to Calcutta line as the first extended trunk line, to be followed by one from Bombay to Delhi. These will be completed in about 12 months. With regard to experiments to find the longest distance which can be spanned by a continuous trunk line without an intermediate repeater installation, conversation has been carried on between Bombay and Nagpur (520 miles) and Bombay and Ratlam (410 miles). Conversations over such long distances cannot be heard distinctly enough for commercial purposes, but for private conversation these trunks are good enough. The next longest-distance trunk is that between Bombay and Ahmedabad, about 315 miles, and this has proved a complete success as regards distinct speech.

THE UTILISATION OF SCATTERED WATER POWER.

By IAN M. E. AITKEN, B.Sc.

[*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS (N.W. CENTRE, STUDENTS' SECTION) *on December 5th.*]

PRESENT-DAY hydro-electric practice almost entirely confines itself to the utilisation of large water powers to supply individual generating stations, and, for power schemes, neglects the cumulative value of smaller scattered water powers, even when only the latter are available. Prejudiced adherence to this practice would appear to be the chief reason why much money is often expended on costly civil engineering projects for the concentration of several water powers at one site in sufficient quantity to justify the erection of a central hydro-electric generating station of the usual type. Since electrical power transmission lines form the most ideal collectors of power, it would appear to be far more advantageous to investigate some economical electrical scheme which would allow the water powers to be separately utilised at their respective sites and connected up electrically. In order to reduce the costs of operating labour, the generating units should be robust and should operate automatically, being remote-controlled from one point. Automatic generating stations of various types have been in operation in America for some years past, and have rendered remarkable service. In one or two isolated cases the generator has been simply a large alternating-current induction motor, driven above synchronous speed and thus feeding into the line, from which it receives its magnetising current. An induction generator has many features in favour of automatic operation, and feeds the total available driving power into the line by running up beyond synchronous speed (*i.e.*, with a negative slip) as much as is required to consume that power; but it cannot generate unless the line is already "live."

With a steam station to stabilise the line conditions (voltage and frequency), it therefore appeared to be an ideal solution of our water-power problem to connect up a large number of these automatic induction generator units, and thus to develop our smaller water powers. But, in attempting to supply an industrial load (always of "lagging" electrical power factor) by means of a system dependent for its generation mostly on induction generators (which generate at an uncontrollable "leading" power factor), the steam station would also be saddled with the responsibility of supplying at least a large lagging "wattless" current (*i.e.*, a current with no power in it) in order to negative the discrepancy between the power factors of supply and demand. Under the best present-day conditions, this "wattless" current would be approximately equal to the total current required by the load and, for its supply, the steam station alternators would require to be of such a size that, in themselves, they would be able to supply the total load direct, with an increase of cost (for extra steam-raising and turbine plant) far less than the cost of the entire hydraulic development.

This obstacle appears, at first, to be insurmountable, but the following suggestions so far overcome the difficulties that the electrical necessity for alternators—even to stabilise the line conditions—disappears altogether, thus allowing the induction generator units to form the sole source of electrical power supply. The problem of the "wattless" current is solved by the judicious employment of methods of power factor correction. If an electrostatic condenser, connected across the terminals of the induction generator, were of such a size that it corrected the power factor to unity, the cost/kVA of the generator would not be increased beyond that of large alternators, and, at the same time, the line costs would be reduced to the absolute minimum. Unity load power factor, on the other hand, could be obtained by charging heavily for lagging currents, and so forcing customers to use only motors of good power factor. All large synchronous machines (*e.g.*, synchronous or synchronous-induction motors and rotary converters), particularly those in the power company's sub-stations, could be equipped with a field current regulator operated from the line voltage. This would automatically stabilise the line voltage and at the same time ensure that the power factor of the total load would be of the required value. The line frequency would be stabilised by setting the water-turbine governors to regulate the speed to a constant value which corresponds to the full-load output of the generators at the frequency required. Automatic control of the generating units would ensure that the number in operation would approximate to the load required if each unit ran at 100 per cent. output.

The remaining discrepancy would automatically vary the output of every generator to satisfy the new load requirements. For example, suppose that the load increased when the units were running at 100 per cent. output (*i.e.*, frequency normal), and that the number running remained unaltered. The synchronous motors would tend to slow down—some due to extra mechanical load, and the others due to temporarily acting also in part as alternators—so that the frequency of the system would tend to follow suit. This would immediately increase the slip and output of the generators, the frequency being reduced to that value which will cater for the new load. With 50 periods normal frequency, and 5 per cent. full-load generator slip, the frequency would fall only to 49.9 periods in order to supply 4 per cent. increase in load. A delicate frequency meter could therefore be calibrated to represent the percentage output of every generator running, and would serve as an indication of the times when to start up or shut down any individual unit.

As a result of the continual change of load (rapid fluctuations being catered for by the inertia of rotating masses), and therefore of the number of units in operation, the latter could be divided into two classes—continuously and intermittently running. As a result of this, different kinds of water power can be utilised in the most efficient manner. In high head developments, the costs dependent on the proposed load factor are overbalanced by the costs dependent on the maximum output of the generating station, on account of the expensive pipe-lines involved; so that these developments would best run continuously and employ seasonal storage. On the other hand, low head developments which would not be economically feasible for the supply of power continuously would be able to supply—for the same cost of hydraulic development—several times that amount of power, in necessary kVA of the system (as based on the maximum peak load), if arranged to run between two heads for short periods of time per day and store between runs. For the purpose of this daily pondage, the annual minimum flow would be assumed, because, at low heads, seasonal storage is absolutely impracticable. In the case of this intermittently-running type of unit, the turbine governor performs another function by automatically keeping the gate opening adjusted—as the working head decreases—in order to keep constant the speed of the generator; this gives constant output at constant frequency.

For hydraulic reasons, a steam station might form part of the layout of a large scheme, or an existing steam station might be connected in. In either case, it would be free to supply only power current, and would give greater stability to the system. It would also form an ideal central control station, since observation of its output would give indication of any load change. Geographical considerations would naturally arrange the generating units more or less into groups, and, in order to reduce line costs, the units forming each group would be connected up—and controlled from—a local control station, akin to a telephone exchange. This station would be in direct communication with the central control station, and would also act as a transformer station, feeding the main lines at, say, 11,000 volts and the generating units at about 2,000 volts. In cases where water power and load are adjacent, these local stations would also act as distributor sub-stations.

I have worked out, in detail, wiring diagrams for the automatic control of the generating units, and it becomes a wonderfully simple matter to protect every item of the entire apparatus by the same protective gear as that which is normally utilised to safeguard the overhead transmission lines.

The development of our scattered water powers must necessarily come through time, for our coal resources are steadily diminishing. I hope that I have produced a scheme which will bear investigation and, even at the present time, be able to undercut the steam station. Since the generation is allocated to a number of small units, the necessary percentage of stand-by plant would not be anything like so great as when the responsibility is borne by one or two large alternators. Enlargement finds no restrictions, and a very small percentage of the total work would be finished before the commencement of generation. The same cannot be said of schemes dependent on large generating stations.

On account of the fact that the small induction generator units may form the sole source of power, the foregoing principles easily apply to the layout of a separate power scheme for an individual, isolated consumer (*e.g.*, a paper mill—its site being already chosen adjacent to ample natural water supplies, for process reasons), with automatic control from the power-house. Such developments could ultimately be connected up into one extensive system, so that the individual consumer might well take the lead in the comprehensive utilisation of our scattered water power.

Finsbury O.S.A. Smoking Concert.—The Finsbury Technical College Old Students' Association is to hold a smoking concert at the Engineers' Club on January 19th, when the chair will be taken by the new president, Mr. W. M. Mordey, M.I.E.E., at 8 p.m. Tickets (2s. 6d. each) may be obtained from members of the Council or from the hon. secretary, H. P. Guy, 74, Silver Street, Edmonton, N.18. An informal dinner at 6.45 p.m. has also been arranged; intending diners should notify Mr. Guy previously.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

An Electric Welding Set.

The accompanying illustration (fig. 1) illustrates a complete electric welding plant supplied by the PARSONS MOTOR CO., LTD., Town Quay Works, Southampton. The whole equipment—petrol-paraffin engine, fuel tank, generator, switchboard, and exciter—is mounted in the same framework of channel and angle iron. It will be seen that the engine and generator are direct-coupled, and the exciter is connected by a plain coupling. The plant is ready for immediate use, requiring only cable leads and electrode holders. The engine is substantially constructed and provided with an enclosed governor capable of controlling within very close limits as is necessary with this class of work.

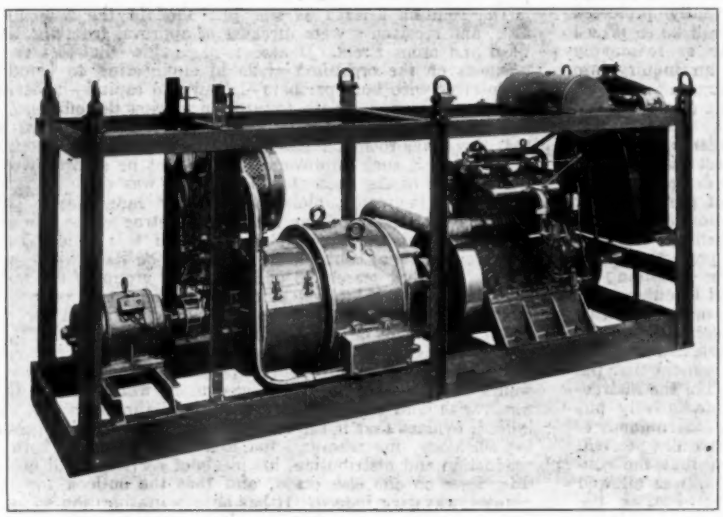


FIG. 1.—AN ELECTRIC WELDING SET.

A Small Electric Light Dimmer.

A neat and compact type of dimmer has been designed and produced by the IGRANIC ELECTRIC CO., LTD., 147, Queen Victoria Street, London, E.C.4, for use in kinemas, small theatres, concert halls, churches, dance halls, skating rinks, and other such places where the lighting installation consists of only a small number of lamps. These dimmers are suitable for continuous duty on either direct- or alternating-current circuits, and are capable of controlling metal-filament lamps up to 2,640 W. The dimmer is of the pattern illustrated in fig. 2, consisting of either one or two circular plates, bolted together and operated by a single lever. The standard dimmer is arranged for fixing flat against the wall, with the operating lever in front. If desired, however, it can be supplied fitted with a bracket for supporting the plates at right angles to the wall or rear of board fittings, with hand-wheel "drive."

FIG. 2.—AN "IGRANIC" DIMMER.

A Crypto Variable-Frequency Alternator.

The Crypto variable-frequency alternator has been designed to provide a source of a.c., the voltage and frequency of which can be changed at will. By means of speed variation and a simple pole-changing device, it is possible to obtain a four, or more, to one frequency variation. The revolving field of the alternator is so arranged that the salient poles thereon can be made N. and S. or N.N S.S. alternately by means of a double-pole change-over switch. The armature or stator of the alternator is wound with main and accessory coils, the uses of which can best be explained from an actual example. The fields of an alternator wound, to give a periodicity of from 40 to 160 cycles per second and speed a variation of from 800 to 1,600 r.p.m. would be arranged to give either 6 or 12 poles. The stator would be so wound that with the main coils only in circuit a 12-pole stator would be produced. By means of a double-pole change-over switch, a 6-pole stator would be formed by the main and accessory coils, the purpose of the latter being to help give a smooth wave form as near sinusoidal as possible. The two change-over switches referred to are coupled together, thus making it a very simple operation to change the number of poles in the field and stator. Buffer resistances are provided, into which the two field circuits can discharge at the moment of breaking the circuit. The necessary speed variation is obtained by the motor field rheostat in the case of a motor-alternator set, and the voltage regulation with tappings is governed by the alternator field regulator and static transformer.

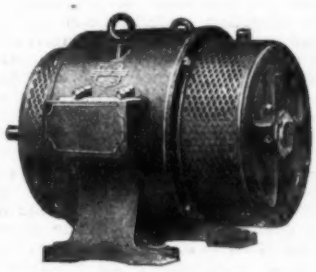


FIG. 3.—CRYPTO ENCLOSED VENTILATED VARIABLE-FREQUENCY ALTERNATOR.

FIG. 4.—THE WRISON INSULATING BUSH.

The stator is built up of laminated core plates, and the windings are subjected to vacuum drying and impregnation with insulating varnish. The revolving field likewise consists of laminated plates assembled on the shaft and clamped between substantial flanges. The field coils are former wound and are impregnated in vacuum before being assembled on the poles of the field. Absence of vibration is obtained by careful balancing, and the completed rotor is trued up between centres to ensure a uniform air gap. The slip rings are shrunk on to a cast-iron hub over a micanite sleeve, and the brushgear is of the box pattern, in which the brushes are fed forward by a lever held in tension by an adjustable spring. The terminals are mounted on mica-insulated steel rods and enclosed in a cast-iron terminal box, which can be screwed to suit the customer's requirements. Ball bearings are fitted to all standard machines, but ring-lubricated bearings can be supplied if desired. The accompanying illustration, fig. 3, gives a good idea of the external view of the machine, which is made by the CRYPTO ELECTRICAL CO., LTD., of Acton Lane, Willesden, N.W. 10.

A Patent Grip Insulating Bush.

The WRISON BUSH CO., 37, Moorfields, Liverpool, has sent us a sample of its patent rubber bush for insulating the ends of conduit. This fits tightly into and around the conduit, preventing its slipping off. The bush is shown in section in the accompanying illustration (fig. 4).

E

LEGAL.

Breach of Electricity Regulations.

Clyde Shipbuilding Firm Fined.

In the Dumbarton Sheriff Court Sheriff Menzies gave his decision in the case against Messrs. Napier & Miller, Ltd., shipbuilders, Old Kilpatrick, at the instance of the Factory Inspector.

The firm were charged with three separate offences under the Factory and Workshops' Act, 1901 to 1911. To the second and third of these charges—failing on September 29th to have posted in the works the Electricity Regulations, and failing to have posted in the works the instructions for treatment of men injured by electric shock—pleas of guilty were tendered. The first charge, to which a plea of not guilty was tendered, was neglect of a regulation made by the Secretary of State, which provides that "all conductors shall either be covered with insulating material, and further efficiently protected where necessary to prevent danger, or they shall be so placed and safeguarded as to prevent danger as far as reasonably practicable." The case arose subsequent to an inquiry into the death of a man who was killed by coming into contact with an electric conductor passing over the roof of the smith's shop, on which he was engaged painting.

The Sheriff, in his decision, said the respondents asked him to find them not guilty of the charge in respect that (1) they had so placed the conductor as to "prevent danger." The means adopted to this end were the raising of the conductor to a considerable height off the ground on poles, and then passing it on to the ridge of the roof of the smithy; and also (2) by so safeguarding the conductor as to prevent danger, and the means adopted to this end were the arranging to switch off the current when the workmen had to enter what was called "the danger area" in the execution of their instructions. This attempt to discharge the onus accepted by the defenders failed; he therefore reached the conclusion that the respondents were guilty of the offence. An argument that the deceased met his death solely through his breach of the instructions given to him by the respondents was tentatively put forward, but in the face of the decision in Fotheringham *v.* Babcock & Wilcox, Ltd., it could not be successfully pressed. The evidence left on his mind the impression that the conductor in question, which was erected in 1906, was allowed to continue in the state in which it was erected after the regulations affecting it were issued in 1909, instead of being changed over then to meet the regulations, and that it was so left unchanged on the sporting chance that, by care on the part of the staff, nothing would happen to bring the state of the conductor in question actively within the sweep of the regulations. The offence found proved seemed to him to be a very serious one, in view of the long continued neglect of obvious and efficient practical safeguards to prevent danger, danger of which the nature was lucidly illustrated by the fatal result in that case. He imposed a penalty of £70 for the charge found proved, and £2 10s. fine for each of the two charges to which there was a plea of guilty, with £2 costs.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Society of Technical Engineers.

The remarks, indeed the criticisms, of "Salvo jure" on the Society of Technical Engineers, and those of others who from time to time have given expression to opinions of a similar character, are in one sense an encouragement to those who are doing what they can to build up that Society. The gist of his complaints appear to be that the growth of the Society is slow, and that too little publicity is given to its endeavours. That he and others should feel this is evidence that they share the opinion that some organisation of engineers for purposes other than those connected with the development of engineering science is needed. But why do he and those who feel with him not associate themselves with us in the enterprise of creating that organisation?

The preliminary work has been accomplished. A constitution has been settled with meticulous care so as to provide every possible means for the expression of individual opinions, and of minority views; machinery is provided for safeguarding and securing both local and sectional interests. Moreover, this constitution provides quite unusual facilities for every individual, who is willing to do any work on any of the many questions with which we are concerned, to bring his grist to the mill which is grinding out, surely if slowly, the plans and policy of the Society. The machine has been so designed and built that by means of committees and sub-committees an almost indefinite number of members can contribute effectively to the work of the Central Executive. Our difficulty is to find the necessary number of men able and willing to do that work. Not only has a constitution been thus designed, suitable to the intensely individualist character of the engineer, but the broad lines of a policy have been carefully worked out. In hammering out that policy regard has, of necessity, been paid to the peculiar difficulties of the case—difficulties which arise from the fact that it is desired to include in our organisation not only the younger men of subordinate position but those also who hold positions of high responsibility; men, that is, of all grades from those immediately below the rank of managing director down to those recently joined from the technical colleges and those promoted from the ranks of the foremen.

That being so, it was obvious to all concerned that the first question to settle was whether such a Society could, or should, associate itself with the labour movement in joint efforts to promote improved conditions of service, or whether it should stand apart from that movement and, if so, whether it should associate itself in some way with the interests of the employers and, if so, in what manner.

The solution arrived at was published in the autumn of 1921, and received a wide measure of approval from the technical and other Press. It amounted to this—that it was the business of the organised staffs in engineering to associate themselves with both partners—labour and capital—in earnest endeavours to find a path towards increasing the efficiency of the industry with which we are all associated. It was felt that there was room for much improvement in that direction, indeed that if such improvement could not be secured within the lifetime of the present generation it was doubtful if the engineering industry, along with other industries of this country, could hold its own in the fierce struggle for markets, success in which is absolutely essential if this densely-populated country is to continue to exist at all on its present basis. It was felt that merely to add one more group to the many that fight for self-interest alone would be not to contribute anything to that essential aim, but would be merely to add one more element of difficulty and discord. It was felt that if any group could find a means of giving a lead, both to the labour movement and to employers, in that high enterprise, it would be that one which included those who were in daily touch with both those other partners in the industry. It was, indeed, evident that if the technical engineer with his passion for efficiency, his training, his high responsibilities both in production and distribution, his ideals of service, could not do this, then no one else could, and that the outlook for this country was dark indeed. It has been a gratification to us to find, from experience, that already in some at least of those large firms in which we have a considerable membership the fact that the staff has been organised as a group within this Society has resulted in smoother working of that staff and thus that the efficiency of that staff has been increased.

It was, accordingly, decided that we should attempt this task and devote ourselves to it, and that until we could secure some understanding of this objective on the part of the manual workers it was necessary to stand aloof from them in the struggle for personal ends, but that we should propose to their trade unions that we should join with them in inquiring into every possible means of producing more things so that there should be more things to divide between them, ourselves, and the owners of the means of production and exchange. Many informal conversations have been held with representative men belonging to both groups, and some clear progress has been made towards the elements, at least, of some understanding on these matters. It is clear that during these preliminary stages ground might be lost rather than gained by undue publicity. But the time is approaching when some more definite statement can be made on these subjects.

But there is another, less ambitious but yet difficult, side to our work, namely, that concerned with the direct interests of our own group, and in this also we are making some progress. At frequent intervals there appear in the Press comparisons of our efforts in this direction with those of other bodies—especially such a body as the Electrical Power Engineers' Association. It is argued that if that body, with a limited field, can enrol a very large proportion of the engineers concerned and can secure for them advantages in pay and conditions, why cannot this Society, with a wider field, do as well or better? With all respect, Sir, to those who ask that question we would suggest that our problem is much more difficult, and not more easy, than that of the E.P.E.A., apart altogether from the considerations set forth above which touch our wider objectives.

In the case of the E.P.E.A. we see a body of men who were, admittedly, gravely underpaid—a body of men easy to grade, performing a series of definite operations, confronted by a group of employers whose organisation was not comparable with that of the engineering manufacturers—employers, moreover, who did not, as do the manufacturers, and in large measure rightly so, regard their staff as their mouthpiece. The Power Engineers may have been right or wrong in the line they took two years ago when they threatened a national strike on the question of the adoption by the employers concerned of a schedule of pay and conditions of service adopted by a Joint Council of Employers and Employed which they had succeeded in establishing—but if we had wished to take such a path it was not open to us to do so for a multiplicity of reasons, which, apart from our difference in outlook, must be obvious to anyone having any knowledge of the question.

In any case it is evident that while power engineers may be graded for pay, it is not possible, or desirable, to grade for that purpose the higher ranks of the technical engineers. With them there is no known means of determining a rate of pay other than what each can secure for himself. We have made some progress in inquiring into the question of grading for the junior ranks, but even there the matter is full of difficulty.

There are, however, other matters which do not raise questions of that order, such as those of an employment bureau and unemployment insurance and superannuation, and in these also we have made some progress; indeed, some particulars of our unemployment insurance scheme were published in your journal, and elsewhere, a week or two ago.

What we need now is the help of new members to join us in working out this first and non-contentious business of insurance and in the placing of engineers both for their own benefit and that of the firms who need them. We need more members also for the obvious purpose of increasing the funds available for our work; and we suggest that if those who complain that we do not make progress, such as they would like to see, would join us and devote their energies to constructive work from within this Society rather than to criticism from without, then both they and we would be the gainers.

Society of Technical Engineers,
NORMAN WYLD,
Director.

London, *December 23rd*, 1922.

P.S.—I notice that one of your correspondents, "Organisation," in your issue of December 22nd, remarks that "It is, of course, generally recognised that the S.T.E. does not cater, as a protective organisation, for the technical engineers and, from its constitution, cannot do so." We should be glad to learn why our constitution prevents us acting in the manner suggested, because it was carefully designed for the purpose of giving us every possible freedom of action subject, of course, to the desires of our members.

The recent communications from "One of Them" and "Salvo jure," which figured in your "Correspondence" columns will, I feel sure, interest a large number of technical engineers whose names were on the foundation list of members of this society and have since ceased to be members, and also those remaining foundation members, who, like myself, have paid their subscriptions up to date in the hope that the society would eventually justify its existence.

I consider that "One of Them" made a very fair comparison—or rather contrast—between the E.P.E.A. and the S.T.E., and the remarks of Mr. Wyld with regard to disguised propaganda for the E.P.E.A. were an adroit evasion of the points at issue, as of necessity, progress of a movement can only be judged by comparison with a similar body.

The questions which "Salvo jure" asks in the sixth paragraph, can all be answered with a decided affirmative, and as a member, I have frequently protested against the "anæmic" and indefinite policy which has been pursued by the Council.

Foundation Member, S.T.E.

December 23rd, 1922.

The Ambiguity of the Implications of the Annual "Load Factor."

I suppose that all who are practically engaged in the business of electricity supply will agree that their fortunes or misfortunes are very much involved in the numerical expression usually called the "load factor," by which, ignoring constants, is meant the ratio of the output during a given time to the maximum instantaneous demand during the same time. It seems to be usually assumed that this ratio expresses the degree of constancy of the demand or, in other words, the flatness of the demand-time diagram, such flatness being the ideal which the power-station engineer, as such, lives for. My purpose in this letter is to draw attention to the fact that when the time is fairly long—say a year—the load factor may express something very different from constancy or "flatness" and that, consequently, the implications are ambiguous and may be quite misleading. Suppose, for example, that the daily load curves of two power stations possess the property with respect to each other which the mathematicians call "similarity," but in one case the daily maximum remains constant whilst in the other it grows in vigorous and cheery fashion. The long-period load factors will now differ greatly though the "constancy" of the two outputs is similar; and the more rapidly the daily demand increases in the second case, the more *inferior* its annual load factor will become. So a low load factor for a year may mean a depressingly spasmodic output or a welcome expansion of the demand or any inextricable mixture of these things. Of course, too, a falling-off in the demand would have just the same effect upon the yearly load factor as an increase.

Clearly a new definition of the load factor for the year is needed if the ratio is to express the "constancy" idea. The ideal thing would be to take the mean daily load curve for the year. If, as a short cut, we divide by the mean of the monthly maxima instead of by the actual maximum for the year, the former procedure would, of course, always give a load factor superior to that obtained by the latter; and, moreover, we should *not* so obtain the mean of the monthly load factors.

Anyhow, the yearly load factors calculated in the usual way do not tell us what we wish to know when comparing supply statistics, and so I hope that someone will suggest something which will really express the idea intended.

H. G. Rowledge.

Peterborough,
December 23rd, 1922.

Improvement of Power Factor.

I am more than delighted with your "Correspondence" columns in your issue of December 29th, 1922, as at last I appear to be getting some useful criticism in a friendly spirit. But the aforesaid correspondence simply bristles with interesting and extending points. However, I will endeavour to confine myself to the two main points on which we do not appear to quite agree; prefixing but one generality. *Apropos* of "Practical Commercial Proposition," if the £ s. d. cost of any power-factor improving apparatus is not appreciably less than the total outlay involved in extending the whole of the supply capacity of the entire system of the undertaking, then it is a paying proposition to let the question of power-factor improvement "go hang," and to provide further kVA capacity right from the station building up to the consumers' terminals. One authority on this subject has laid it down that if the supply authority's capital outlay, divided by all costs incurred in providing power-factor improving devices, does not equal a lower figure than the sine of the initial angle of lag, then power-factor improving devices are not a paying proposition. Your correspondent, writing from the shade of Helsby Hill, gives some very useful information; to wit, if condensers of the 600-volt type, *i.e.*, his firm's standard, are applied to a 400-volt system, the cost of his £200 apparatus will be increased by approximately 30 per cent., whilst for the 200-volt case the excesses will be nearer 50 per cent. It must be something like three years since I had a "brain wave" concerning resonating with condensers, *cum* auto-transformers, &c. About a year back I was discussing this subject with a certain professor of electrical engineering who remarked: "Too late, my child, I have myself tried and found that owing to previous patents concerning the application of transforming devices as applied to condensers for power-factor improvement, that trench is already filled in!"

At present only two firms in this country are interested in power-factor improvement by condensers. Mr. E. W. Dorey has kindly furnished one name, whilst your Cheshire correspondent obviously represents firm number two, the original firm to put a workable solution on the market. Mr. H. Higham refers to a saving of 100 per cent. per annum and higher; whilst deeply appreciative of the condenser power-factor improvement solution, I presume he does not imply that any supply authority's tariff is such as to enable a consumer to obtain kW-hours for nothing.* Mr. C. Jones rather changes his ground. Originally, he referred to from 400 to 500 volts. Now he says: "In my own particular case, the condensers are connected direct at 600 volts." This rather supports my original statement at the I.E.E. meeting which has caused this correspondence. Mr. L. F. Fogarty asks a very fair question at the end of his letter, which, not being a patent agent, I am not at the moment in a position to answer beyond what I have herein written. In conclusion, with your approval Mr. Editor, I submit the following single-phase problem which came before me in May, 1922:

A small single-phase installation comprised 8 motors, totalling 28.5 h.p. The sum of the individual h.p. demands at 746 watts equalled 22 h.p.

The sum of the individual kVA demand = 20.955.

The sum of the individual kW demand = 16.192, which, I believe, corresponds to a power-factor of 0.772 or 77.2 per cent.

With your permission, Mr. Editor, will Mr. Higham kindly submit to your columns an actual quotation for improving the power-factor of this 50-cycle case to 0.95 at 600 volts. Then, perhaps, Mr. Dorey will do the same, taking as his basis 200 volts, 50 cycles. If complied with, the answers should clear the air.

W. E. Rogers.

London, *December 31st*, 1922.

*A saving of 100 per cent. of the cost of the apparatus is meant; the reference is not to the cost of energy.—EDS. ELEC. REV.

It is not possible in a short letter to refer in detail to the commercial application of condensers connected to low-pressure circuits, such as 200 volts, but this matter will be dealt with at some length in an article which I have in preparation for your Journal. I think that Mr. Rogers must by now be satisfied that the statement he made was quite unjustifiable.

The installation of a static condenser is usually considered for one of two reasons: either to avoid capital expenditure on mains, transformers, &c., or to make more efficient use of them; or to reduce the power supply bill where the consumer is charged on kVA demand. The capital cost and relative saving effected by a condenser depend upon:—

1. The voltage of supply.
2. The frequency of supply, the size of condenser being directly proportional to the frequency for a given kVA output.
3. The power factor of the load, a smaller condenser being necessary to correct a given load from .6 to .8 than to correct from .8 to unity.
4. The amount of the penalty or bonus for power factor, which is usually the equivalent of about £4 6s. per kVA per annum.

I have an actual case where the condenser is designed for working on a 200-volt single-phase supply at 100 cycles through an auto-transformer stepping up from 200 to 600 volts, the cost of the condenser equipment being approximately £300, and the saving on the supply bill between £290 and £310 per annum. This admittedly is a very favourable case, but even with a 50-cycle supply and 200 volts it is not difficult in the majority of cases, to show a saving of 50 per cent. per annum or more of the capital expenditure.

I have another case, where the consumer purchased a condenser with auto-transformer operating on public mains at 415 volts, 3-phase, 50 cycles, costing £250, and is charged on a basis of 25s. per kVA per quarter; the condenser effects a saving of between £160 and £180 per annum.

I could quote a number of similar instances, but this will suffice to prove that, contrary to Mr. Rogers's statement, the static condenser is, in the majority of cases, a sound commercial investment.

E. W. Dorey.

London, *January 2nd*, 1923.

The Stage and Advertising.

I often wonder why more use is not made of the splendid advertising possibilities of the stage. Take, for instance, the average "stage fire," an affair of red paper waving in a breeze. How much more simple an electric fire would be. There would be no need to disguise it; it could be shown simply as an electric fire, and there the matter would end. Many firms would be only too pleased to lend a fire for this purpose, especially if the fact were mentioned on the programme. As an example of the effect of stage advertising, the telephone stands supreme, and there is no doubt that the G.P.O. owes a great deal to the publicity afforded by its use in the theatre. Perhaps the E.D.A. can do something to push this form of advertising.

R. E. Gamley,
Sales Department,
Electrical Distribution of Yorkshire, Ltd.

Leeds, *December 30th*, 1922.

That Little Window!

My question to Mr. Wallace Attwood at his first E.D.A. Salesmanship Lecture as to how he would sell through a foot-square window appears to have created considerable interest. In the discussion at the third lecture, I noticed that Mr. E. E. Sharp considered Mr. Attwood's reply to my query as incomplete. May I now through your valuable columns and on behalf of many hundreds of electrical salesmen carry the matter a stage further?

The E.D.A. conferences will help to make better salesmen, but are they to be without their influence on the buyer? Of what use will be our white collars, shaved faces, clean nails, smart clothes, polished boots and engaging smiles if that little window is still to intervene?

The Inquiry Window is legitimate enough, but the buyer need not flatter the salesman to the extent of conducting interviews through it. With many large firms the little window has given place to the open counter and waiting room, but this embarrassing device is still all too common in the electrical industry. I hope it may soon be piled on that scrap heap of barriers which the E.D.A. Conferences have already broken down.

Away with that little window!

W. E. Warrilow.

London, *January 1st*, 1923.

BUSINESS NOTES.

The "Electrical Review" Index.—The Index to Vol. XCI of the Electrical Review, which will shortly be printed, will be supplied only to those who specially apply for it through the post. To these it will be supplied for 6d. post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make early application therefor to the Publisher, Electrical Review, 4, Ludgate Hill, E.C.4.

Bankruptcy Proceedings.—W. Price & Co., electricians, 29, Russell Street, Plymouth.—First meeting, January 8th, at 7, Buckland Terrace, Plymouth; public examination, January 26th, at the Western Law Courts, Plymouth.

R. H. Liddell (Liddell & McInnes), electrical engineer, 4, The Crescent, Carlisle.—Trustee, Mr. K. J. Hough, Official Receiver, 34, Fisher Street, Carlisle, released December 20th, 1922.

F. Wilde (Liverpool Engineering Co.), electrical engineer, 18 & 20, Vauxhall Road, Liverpool. First meeting January 11th, at the Official Receiver's offices, 11, Dale Street, Liverpool. Public examination February 13th, at the Court House, Liverpool.

R. S. Magson (R. S. Magson & Co.), electrical engineer, 10, Stoney Stanton Road, Coventry.—Last day for proofs for dividend January 17th. Trustee: Mr. C. J. Band, 9-11, High Street, Coventry.

Sequestration.—Martin & McGregor, electrical engineers, Coltness Road, Wishaw.—Public examination at the Sheriff Court House, County Buildings, Hamilton, on January 9th. Meeting of creditors at Mr. W. B. Galbraith's offices, 87, St. Vincent Street, Glasgow, March 28th.

Company Liquidations.—Isleworth Rubber Co., Ltd.—A petition for the winding-up has been presented to the High Court by this company, and will be heard in London on January 16th.

Sykes & Sugden, Ltd.—Winding up voluntarily. Liquidator, Mr. H. V. Wood, District Bank Chambers, Huddersfield. Meeting of creditors, January 10th, at the George Hotel, Huddersfield.

The T.B.S. Electrical Construction Co., Ltd.—A first and final dividend of 10½d. in the £ (to unsecured creditors, £4,389) has been paid by the liquidator, Mr. F. C. Goodman.

Modern Electrical Supply Co., Ltd.—A petition for the winding up or alternatively an order for the continuance of the voluntary winding-up, subject to the supervision of the Court, has been presented to the High Court by the General Electric Co., Ltd., and will be heard in London on January 16th.

Radio Electrico, Ltd.—Winding up voluntarily. Liquidator: Mr. A. W. Deering, 3, Broad Street Buildings, Liverpool Street, E.C.

Peckham Truck & Engineering Co., Ltd.—Winding up voluntarily, with a view to the sale of the company's assets to a new company about to be formed under a similar name. Liquidator: Mr. D. Haslett, 26, Audrey House, Ely Place, E.C.

Sanitas Electrical Co., Ltd.—The Controller and Liquidator, Mr. J. Fraser, of 31, Copthall Court Avenue, E.C., appointed by the Board of Trade, under the Trading with the Enemy Amendment Act, 1916, to carry out the winding-up order is applying for his release; any objections must be sent to the Board of Trade Companies' Department, Great George Street, S.W., before January 17th.

Trade Announcements.—Mr. Terence G. Bacon, formerly with the St. Marylebone electricity supply undertaking, and latterly with the English Electric & Siemens Supplies Co., Ltd., has started business as an electrical engineer and factor, trading as Lighting, Heating & Traction Supplies Co., 43, Doughty Street, W.C.1.

Messrs. F. N. Pickett et Fils, of Wimereux, France, have removed their head offices to Dannes-Camiers, par Neufchatel, Pas-de-Calais, where all business excepting Neufchatel sales will be transacted. The sales organisation is now installed at Hangar "R," Bassin Loubet, Boulogne-sur-Mer.

The firm of Wilson & Herd, of Johannesburg, has formed itself into a limited liability company (incorporated in the Transvaal) under the name of Wilson & Herd, Ltd. The partners of the firm are the sole shareholders. The company is now acting as managing agents in South Africa for the British Thomson-Houston Co., Ltd.

We are informed by Messrs. E. A. Ingold, Ltd., of Bradford and Hampstead Road, London, that Mr. E. A. Ingold is not now connected with the company, and that the name of the company will be changed to Hoffmann Bros., Ltd., with Messrs. J. M. H. & S. L. F. Hoffmann as the sole directors.

Messrs. Crow, Toogood & Co., of 56, High Street, Charing Cross Road, W.C.2, who are opening a wireless department, desire to receive manufacturers' price lists.

The new London address of Messrs. Connollys (Blackley), Ltd., is 53, Victoria Street, S.W.1. Telephone No.: Victoria 3512.

Catalogues and Lists.—The Cambridge & Paul Instrument Co., Ltd., 45, Grosvenor Road, S.W.1.—An illustrated mailing card dealing with the "Cambridge" portable CO_2 and temperature indicator.

Magic Appliances, Ltd., 159, Westminster Bridge Road, S.E.1.—A price list of lead-covered and v.i.r. cables, flexibles, &c.

Messrs. P. L. Dwyer & Co., 30, Grosvenor Place, S.W.1.—January price list of electrical materials and accessories, cables, wires, conduits, switchgear, &c.

MESSRS. ISENTHAL & CO., LTD., Denzil Works, Willesden, N.W.10.—An illustrated pamphlet describing an automatic voltage regulator for d.c. generators up to 50 kW.

MESSRS. J. H. TUCKER & CO., LTD., King's Road, Tyseley, Birmingham.—A folder (No. 9) containing a selection of technical Press appreciations of "Tucker" quick-make and quick-break tumbler switches.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., U.S.A.—An illustrated pamphlet describing automatic starters and controllers for adjustable-speed motors; also a booklet dealing with silent (micarta) gears.

THE JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, S.W.1.—Cooker Pamphlet B, illustrating a number of types of electric cookers. Fully priced.

MESSRS. WATSON & SONS (ELECTRO-MEDICAL), LTD., Sunic House, Parker Street, Kingsway, W.C.2.—Bulletin 51s, illustrating and describing the "K.B.B." mercury vapour lamp for therapeutic treatment.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Booklet No. H. 2831, containing illustrated descriptions and reduced prices of "Magnet" electric fires, &c.

Also Booklet H. 2860, containing illustrations, particulars, and reduced prices of a variety of domestic electrical appliances, including boilers, immersion heaters, cookers, kettles, irons, &c.

MESSRS. CROSSLEY BROS., LTD., 139 and 141, Queen Victoria Street, E.C.4.—A brochure "Dearer Coal and Cheaper Power," dealing with coal distillation, and an illustrated booklet describing the use of wood gases for driving engines.

Electricity Supply Commercial Association.—This Association's address changes as from to-morrow to:—7, Phineas Pett Road, Eltham, S.E.9.

Calendars and Diaries.—MESSRS. FRANCIS POLDEN & CO., LTD., of 56, Cannon Street, London, E.C., have issued a wall calendar with a movable daily indicator and with monthly slips, each of which also gives the complete year.

We have been favoured by the DUSSEK BITUMEN CO., of Empress Wharf, Bromley-by-Bow, E.3, with a most acceptable pocket diary, with card and other pockets, insurance coupon, &c.

MR. HARRY MOSS, of 82, Leeds Road, Bradford, has issued a calendar for 1923, with monthly date slips, on each of which appears a picture designed to lead our wandering and unsatisfied natures back to the land, free from the smoke of the city, rid of the London slum.

THE BRITISH THOMSON-HOUSTON CO., LTD., has sent us a very acceptable pocket diary, containing also useful tables of technical data.

Few desk companions are so welcome as the combined date-indicating blotting-pad, book diary, and memo. slips, for which each year we are indebted to MESSRS. JOHNSON AND PHILLIPS, LTD. This is a most practical and useful souvenir, the absence of which would undoubtedly make itself felt.

MESSRS. MCWHIRTER & SONS, LTD., of Wharf Street, Cardiff, have circulated a calendar with daily slips. The pictorial feature shows a 2,000-kW, 3-phase, 2,200-V, 50-cycles alternator re-wound on site.

MESSRS. W. H. WILCOX & CO., LTD., of 38, Southwark Street, London, S.E.1, have prepared a wall calendar with monthly sheets.

From the SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, London, W.C.2, we have received a block of refill daily slips (1923) for their desk calendar.

From the Publicity Section of the ENGLISH ELECTRIC CO., LTD., 2, Taviton Street, Gordon Square, we have received a calendar, either for the desk or for hanging, with a set of daily slips for 1923.

MESSRS. FULLER'S UNITED ELECTRIC WORKS, LTD., of Woodland Works, Chadwell Heath. We have received a midget set of monthly refills (1923) for their desk calendar and paper weight.

From MESSRS. C. ISLER & CO., LTD., of Bear Lane, Southwark Street, London, S.E.1, we have received a large wall-sheet almanack for 1923, the major portion of the sheet being occupied with interesting pictures and sectional views of artesian well work.

THE IRRADIANT LAMP WORKS, LTD., of 4, Vernon Place, Southampton Row, London, W.C.1, have sent us a brilliantly-coloured wall calendar with monthly slips. They will send "over-printed" show cards and lists to the trade on application.

From the GENERAL ELECTRIC CO., LTD., we have received a neat little "Osram Diary," bound in green leather, with the owner's name printed on the cover. Being slimmer than most diaries, it will occupy but little space in the pocket.

The most interesting New Year souvenir that has reached us is an ash tray and match striker for the desk—at any rate we propose to use it as such until further enlightened. It takes the form of the metal framework and reflector part of a Cosmos radiant fire. It comes, therefore, from THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., of Trafford Park.

A blotter slip for the month of January has been received from MESSRS. W. LILEY & CO., of 62, Hope Street, Liverpool.

MESSRS. BROOKHIRST SWITCHGEAR, LTD., Northgate Electrical Works, Chester (the new name under which Messrs. Brook, Hirst & Co., Ltd., will shortly carry on business, though without change of policy or personnel), have sent a very neat desk calendar in which there are separate cards for the months of January, February, and March, and one for the complete years 1923 and 1924. The three monthly cards give descriptive notes and coloured, illustrations of a drum-type starting panel, star delta starter, and the multiple lever panel.

A calendar for 1923, with an interesting picture in colour above monthly date slips, has been issued by MESSRS. F. V. COLLINS & CO., of 155, Kingston Road, Wimbledon, S.W.19.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, January 2nd: No change in electrolytic copper prices.

Messrs. James & Shakespeare report, January 3rd: Copper bars, sheet and rod, no change; English pig lead, £28, 10s. increase on last week's quotation.

A Christian Order of Industry.—We are informed that in connection with the National Movement towards a Christian Order of Industry and Commerce, to which we made reference a short time ago, a week-end conference is to be held at St. John's College, Cambridge, from January 12th to 15th. The general subject is the "Wages Problem," and among those to introduce the discussions are Prof. J. H. Jones (of Leeds University), Mr. J. W. Madeley (Brass-founders Employers' Association), and Mr. Theodore C. Taylor. There will be an introductory address by Mr. Sydney W. Pascall, and a Sunday evening lecture by Dr. Glover, on "The Application of Christian Principles to Industry." Full particulars can be obtained from the Hon. Secretary, Mr. F. D. Stuart, The Homestead, York.

Social Events.—On December 19th the Maidstone Electricity Department celebrated its 21st "birthday" with a dinner attended by the committee, employés, and many visitors. Councillor Hillier French (the chairman of the Electricity Committee), and Mr. E. E. Hoadley (the borough electrical engineer) replied to the toast of the undertaking. Mr. Hoadley was presented with an electric coffee percolator with tray and accessories (supplied by Messrs. L. G. Hawkins and Co., Ltd.) as a mark of the staff's esteem. The dinner was followed by an excellent concert.

The Osram and Robertson Club held a very successful dance at the Osram-G.E.C. Lamp Works, Hammersmith, on Saturday last. The hall was artistically lighted, and the varied programme, together with an excellent orchestra, added considerably to the evening's enjoyment.

Book Notices.—The "Practical Engineer" Electrical Pocket Book and Diary, 1923 (pp. 636+cxxiv). London: Henry Frowde and Hodder & Stoughton. Price 2s. 6d. net cloth, 3s. net "Pluviusin."—This is the twenty-fourth appearance of this handy work, and, as usual, a great many additions and revisions have been made. Railway electrification is more adequately dealt with in the Traction section, and the notes upon rectifiers have been amplified in the light of recent advances. The important chapters upon radio telephony and telegraphy have been re-written by an expert authority, and the Electric Welding section has been extended. It will be noticed from the heading that the publication has changed hands.

To commemorate the completion of 130 years of existence the *Observer* has published a souvenir, which is well in keeping with the dignity and traditions of the journal itself. It is beautifully produced, and the prints of London in days long past are of the greatest interest. Many of these are reproduced on wood from old prints. In congratulating our venerable, but by no means feeble contemporary, we express the hope that it may long continue to add to the attractions of Sunday.

"The *Journal* of the South African Institution of Engineers." December, 1922. Johannesburg: The Institution. Price 2s. net.—This issue contains the authors' reply to a paper on "The Micro-Structure of Babbitt Metal," and a paper dealing with "Mineral Exploration of the Transvaal." A list of recent Union patents also appears.

"The Electrical Engineer's Year Book and Diary, 1923" (500 pp.). London: S. Davis & Co. Price 21s. post free.—The fifteenth edition of this comprehensive work is smaller by a few pages, but this appears to be due to the condensation of part of the text, as we cannot find that information of any importance formerly included has been omitted from this year's issue.

Sir Isaac Pitman & Sons, Ltd., have sent us a catalogue of scientific and technical books covering a diversity of industries and arts. In practically every case the price, size, and a summary of contents are given.

"The *Journal* of the Junior Institution of Engineers," January, 1923. London: Percival Marshall & Co. Price 2s.—This number contains the address on "The Utility of Theory to the Practical Man," delivered by the President, Capt. H. Riall Sankey, C.B.E., as well as particulars of "lecturettes" and notes from the provincial sections.

"*Journal* of the American Institute of Electrical Engineers," Vol. XLI. No. 12. New York: The Institute. Price $1.

"Electricity in Agriculture," by A. H. Allen. Pp. x+111; figs. 35. London: Sir Isaac Pitman & Sons. Price 2s. 6d. net.

"Science Abstracts A. and B." Vol. XXV. Part 12. No. 300. December 30th, 1922. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"Mechanical World Year Book for 1923." Manchester: Emmott & Co., Ltd. Price 1s. 6d. net.

Business Organisation.—At the Birmingham Branch of the Institute of Cost and Works Accountants on Friday next, January 12th, Sir William Ashley will lecture on "Present Day Tendencies in Business Organisation." The lecture will take place at the Chamber of Commerce, New Street, Birmingham at 7.30 p.m., and Sir William Mills, M.I.M.E., will preside.

Registration of Companies in Constantinople.—Reuter received a telegram on December 22nd from Constantinople stating that the Economy Commissariat of the Turkish Government had issued a communiqué declaring that Turkish and foreign limited liability companies carrying on business in the Constantinople Vilayet must register themselves in accordance with Turkish law. A period of three months as from December 18th is allowed for registration, after which companies that have failed to register must cease operations.

The Australian Commonwealth Board of Trade.—The Commonwealth Board of Trade, which was brought into existence during the war, has been reconstructed and its functions enlarged and more clearly defined, whilst the Bureau of Commerce and Industry has been incorporated with it. As reconstructed, the Board will be an exceedingly important organisation and its functions are as follows:—

(1) To investigate and report upon all matters referred to it by the Federal Government.
(2) Generally to consider and advise the Government upon matters affecting the trade, commerce and industry of the Commonwealth.
(3) To act as clearing house for commercial intelligence to manufacturers, merchants, and exporters, supplying to the commercial community continuous information with regard to specific openings for Australian trade in overseas markets; to collect this information through various agencies in London, America and elsewhere.
(4) To consider and advise regarding the appointment of Trade Commissioners and to define and control their operations.
(5) To prepare the way for the investment of British capital in Australian industry, and point the way to British manufacturers as to the possibility and advisability of establishing themselves in Australia.
(6) To consider and advise on the problems of production and marketing.
(7) To advise as to the desirability of and participation in exhibitions and industrial fairs, and to organise and control Australian representation.
(8) To act as a Key Industries Committee for the purpose of investigating and making recommendations concerning those necessary basic industries which, from a national point of view, should be established and encouraged in Australia.
(9) To provide necessary facilities in the capital cities of the States, whereby the commercial community can bring before the Board any important matters affecting trade, commerce, and industry.

The Prime Minister, in announcing on August 15th, the reconstruction of the Board, stated that the underlying idea was to call into consultation with the Government representative business men, whose services would be gratuitously rendered, for the consideration of industrial and commercial questions that might arise from time to time, many of which had other aspects than those mainly connected with Government policy. The Board comprises, besides three Ministers of the Crown, certain Government officials and several prominent business men, to whose number it was proposed to add as occasion arose.—*Board of Trade Journal.*

International Fair at Cologne.—The industries principally represented at the Cologne Spring Fair will be those of the Rhenish-Westfalian districts, the largest and most productive centre of Germany. The iron and steel trades, technical machinery of all descriptions, and the weaving industry will all have exhibits. The fair will be opened in May, by which time the exhibition buildings will be ready.—*Reuter's Trade Service* (Cologne).

Applications for British Trade Marks.—Below is given a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries. Firms or individuals desiring to enter an objection to any of the applications have one month in which to do so from the dates mentioned below. In the case of foreign firms, the names and addresses of the British representatives to whom objections are to be sent are also given:—

Pharos. No. 429,005. Class 6. Dynamos. Motolite Dynamos, Ltd., Landor Road Works, Shepherds Bush, London, W. December 27th, 1922.

Magnavox Telemegafone. No. 429,527. Class 8. Telephone receivers. The Magnavox Co., 2,725, East 14th Street, Oakland, Cal., U.S.A. (Feeny & Feeny, 73a, Queen Victoria Street, London, E.C.). December 27th, 1922.

Metrovik. No. 428,503. All goods in Class 16. The Metropolitan-Vickers Electrical Co., Ltd., 4, Central Buildings, Westminster, S.W. December 27th, 1922.

P. G. (lettering and dolphin design). No. 429,656. Class 40. Copper wire covered with india-rubber or gutta-percha. Pirelli General Cable Works, Ltd., 144, Queen Victoria, Street, London, E.C. December 27th, 1922.

Commercial Diplomatic Officers in China.—It has been decided to change the headquarters of the two Commercial Diplomatic Officers in China. Mr. H. H. Fox, C.M.G., Commercial Counsellor, has now taken up his headquarters at Peking, instead of Shanghai, while Mr. H. J. Brett, the Commercial Secretary, has moved from Peking to Shanghai. Their addresses are, therefore, now as follows:—Mr. H. H. Fox, C.M.G., Commercial Counsellor, British Legation, Peking; Mr. H. J. Brett, Commercial Secretary, Commercial Secretary's Office, British Consulate-General, Shanghai.

Battery Manufacture in South Africa.—The manufacture of dry batteries has recently been commenced by the Excelsior Dry Battery Co., of 263, Commissioner Street, Johannesburg.

Electricians' Wages.—As mentioned in our issue of December 8th, a reduction of 32 per cent. upon the April, 1921, rates of all grades of electricians, is to be made as from the second pay-day in January, in lieu of the 27 per cent. reduction now in force.

The rates per hour will then be as follows: Grade A, 1s. 8½d.; B, 1s. 6½d.; C, 1s. 5d.; and D, 1s. 3½d.

A Finnish Electrical Manufacturing Film.—The enterprise of the Finnish Electrical Co., of Helsingfors, is shown by the introduction of a film representing the company's manufactures and a number of electrical applications to the industries of Finland. The film was recently presented at the Kino Palats in Helsingfors and is now to be sent around Finland for advertising purposes.

Norwegian Aluminium.—It is reported from Christiania that the S.A. Hoiang Falls Co. has been in negotiation with the Aluminium Co. of America for some time past with a view to economic co-operation, which would result in considerable extension of the production in Norway. The matter, however, has to pass the Norwegian Concessions Law before a decision can be reached, and this question is now under the consideration of the competent authorities.

Trade in 1922.—Reporting upon the position of trade during 1922, Messrs. E. Bennis & Co., Ltd., state that in spite of the adverse conditions, business with them has been practically normal. In the textile trade, however, little or no business is being done, owing to the general bad state of the cotton trade in Lancashire. Very few of the mills are making money, consequently they are not prepared, and in many cases are not able, to invest capital in new plant. On the other hand, there has been a decided move in respect of power station extensions, which involves the ordering of new water-tube boilers and chain-grate stokers, and they have booked several orders for chain-grate stoker plants recently, notably from Bow, Stepney, Croydon, Peterborough, &c. The most profitable sources of business from the firm's point of view at the present time are the colliery areas in South Wales. Messrs. Bennis have developed a stoker that will deal with the South Wales fuels, and South Wales colliery proprietors have proved to be eager to try anything that will improve the efficiency of their boiler plants, which have been notably very low in the past. A number of orders for mechanical stokers and furnaces for various collieries in South Wales are in hand at the present time, and there are prospects of big developments in this direction. Messrs. Bennis's foreign trade is also satisfactory. South Africa seems to be developing considerably, and quite a number of orders for power station plants, electrification schemes, &c., have been placed in this country, and in connection with several of these orders for chain grate stokers have been received. Mechanical stokers and furnaces for Lancashire boilers in Japan have been shipped recently, and other orders for that country are now in hand. Summing up, the firm agrees with the general view that there are signs of the general improvement in trade being steadily maintained during this year.

"Talking Shop."—At the Institution of Rubber Industry meeting, which is to be held at the Engineers' Club, on Monday next, at 7.30 p.m., Mr. Herbert Rogers, F.C.S., will open a discussion on "The Value of 'Talking Shop' with Your Competitor and Others."

The Solution.—A pictorial puzzle advertisement appeared in the ELECTRICAL REVIEW of December 22nd. We are informed by the St. Helens Cable & Rubber Co., Ltd., that the safe having been unlocked, the following correct solutions may be divulged to our readers:—

1. Junction box.
2. Socket.
3. C.T.S.
4. Bayonet holder.
5. Screwed barrel.
6. Ceiling rose.
7. Dead short.
8. Flexible.
9. "N" tape.
10. Rising main (or blow-out).
11. Watertight joint.
12. Bare conductor.
13. Dialite.
14. Taped and braided.
15. Lead covered (L.C.).

For Sale.—Manchester Corporation Electricity Department has for disposal one 1,800-kW Parsons turbo-generator, six Lancashire and four Babcock & Wilcox boilers, (with mechanical stokers), and two Green's economisers, feed pumps, coal conveyor, motors, and electrical jib crane. Edinburgh Corporation Electricity Department invites offers for one 800-kW Willans-Schuckert generating set. (See our advertisement pages to-day.)

Wolverhampton Corporation Electricity Department has for disposal one 1,000-kW turbo-alternator, with condenser, auxiliaries, valves and piping, &c. (See our advertisement pages to-day.)

PUBLIC LIBRARY

Local Exhibition.—The Dundee Corporation Electricity Department and a number of firms supplying electricity appliances are to have stands at the coming Housing Exhibition in the city.

Scottish Electricians' Wages.—The wages reduction proposed by the Electrical Contractors' Association to the Electrical Trades Union, it is stated, has been accepted by the Union after a ballot of the branches. The offer accepted was of a rate of 1s. 5d. per hour, instead of 1s. 7½d. per hour, the new rate to come into operation on January 1st, and to be stabilised to May 1st.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

LONDON.—February 7th to 17th, Business Efficiency Exhibition; February 19th to March 2nd, British Industries Fair; March 4th to 17th, Ideal Homes Exhibition; March 15th to 24th, Photographic Fair; June 1st to 4th, International Mining Exhibition; August 31st to September 22nd, Shipping, Engineering, and Machinery Exhibition.

BIRMINGHAM.—February 19th to March 2nd, British Industries Fair.

DUNDEE.—February 21st to March 3rd, Modern Homes Exhibition.

EDINBURGH.—January 31st to February 14th, Scottish Ideal Homes Exhibition.

HULL.—April 20th to May 5th, International Domestic Economy and Trade Exhibition.

BELGIUM (*Brussels*).—April 9th to 25th, Commercial Fair.

CANADA (*Toronto*).—August 25th to September 8th, Canadian National Exhibition.

CZECHO-SLOVAKIA (*Prague*).—March 11th to 18th, Samples Fair.

FINLAND (*Helsingfors*).—July 1st to 7th, International Samples Fair.

FRANCE (*Bordeaux*).—June 15th to 30th, Samples Fair.
(*Lyons*).—March 1st to 15th, Spring Fair.

GERMANY (*Cologne*).—Spring, 1923. Samples Fair.

ITALY (*Milan*).—April, Samples Fair.

JUGO-SLAVIA (*Zagreb*).—March, Samples Fair.

MADAGASCAR (*Antananarivo*).—August 15th to September 15th, International Commercial Fair.

SPAIN (*Barcelona*).—March 17th to 28th, International Samples Fair.

SWITZERLAND (*Basle*).—April 14th to 24th, Swiss National Fair.

UNITED STATES (*New York*).—February 17th to 22nd, Exhibition of Inventions.

Chinese Notes.—The Sien Hsiung Electric Light Co. at Hungkiang, an important district in Western Hunan, established by Liu Tze-yun and others, has been officially registered at the Hunan Civil Governor's office. The company was formally inaugurated in September, 1922, and a trade licence was also granted.

The Position of Affairs in Australia.—For the benefit of those of our readers who may be directly interested in the subjects dealt with in last week's leaderette in the ELECTRICAL REVIEW on "Empire Resources and Empire Trade," we may quote the views of Mr. S. W. B. McGregor, H.M. Senior Trade Commissioner in the Australian Commonwealth, regarding the general situation in Australia. He says, as quoted in the *Board of Trade Journal* for December 21st, that Australia has reached a stage at which little further progress can be made, or any considerable loans legitimately raised for developmental purposes, without a corresponding increase of population. To those who know Australia, and the average Briton's hunger for the land, combined with his disinclination actually to settle and work on it, the problem of immigration and land settlement is full of difficulties, capable of solution only if dealt with on the wisest and broadest lines coupled with due consideration for the secondary industries.

The outlook is not altogether reassuring. One of the great problems, that of an adjustment of wages to enable industries, as a whole, to be carried on, has not yet been solved. The outstanding example has been the closing of the Newcastle Steel Works, upon which nearly £7,000,000 has been spent, owing to high cost of wages and coal. Australia to-day presents the anomaly of a great food-producing country offering illimitable work of all kinds for developmental purposes, and, at the same time, many thousands of men out of employment who might be usefully at work but for the difficulty as to wages. It is presumed that the impasse will adjust itself eventually but, in the meantime, both employers and employés are suffering considerable losses and there is no encouragement for Australian or British interests to proceed with the industrial development of the country. There is no doubt but that the generous distribution of money in war gratuities, repatriation, war service homes and war pensions (amounting to June 30th, 1922, to £117,500,000), during the past few years has to an extent obscured the true economic position and rendered the payment of high wages an easy matter. This distribution of money is approaching or has reached an end, but the freedom with which money has been circulating during the last few years, also partly caused by the high prices realised for exported produce, necessarily makes it difficult for the workers and people generally to come down to the stern realities of normal production and distribution, particularly whilst the cost of living is still comparatively high. There has fortunately been a run of good seasons for the primary producers, but in the sequence of events in a farming country a bad season or drought is bound to occur before long.

During the year an investigation has been made by H.M. Trade Commissioner Service in Australia as to the number of British manufacturers who have interests of some sort or another in Australian factories. This general term is used as the arrangements vary from complete ownership of the factory to some sort of working understanding. Many Australian manufacturing industries have suffered during the past year from world conditions of depression and upheaval, so that the unfortunate experiences of certain British firms cannot be taken as a criterion of what can be and should be accomplished under more normal conditions. It is inevitable and in the best interests of the Empire that manufacturing industries should steadily develop in Australia. British manufacturers concerned must face the problems involved, which include a small home market, an undeveloped export trade, and, not the least, the labour factor. General advice on this subject is useless as any manufacturer contemplating manufacture in Australia would necessarily investigate the question in considerable detail.

The Pulse of Trade Abroad.—According to information contained in recent issues of the U.S. Commerce Reports, the economic situation in Japan showed improvement in November. A favourable trade balance, a decline in the note issue, a slight decrease in the cost of living, a marked decline in the number of labour disputes, export values of cotton goods increased, and the prospect of an abundant rice harvest, are some of the factors prevalent during October.

In China there was in November a general improvement in the domestic situation with increased demand for goods from the treaty ports; the textile market was rapidly approaching a healthy state. Japanese activity in Manchuria is referred to.

In Spain business activity improved to about normal in November. The cotton mills were working at capacity, and extensive purchases of equipment were being made by railway and tramway companies throughout the country, and for port works and other Government projects.

Swedish industry was reported to be comparatively inactive, but there was relief to the general depression by increasing export movements and the employment of shipping.

The Danish financial situation was reported to have improved, the Landmandsbank crisis had been safely weathered, but industrial activity showed a considerable decrease and practically no capital was being issued.

There was a general improvement in Norway's economic situation. A decline in prices was automatically reducing wages.

In Holland the heavy decline in the German mark was proving to be quite serious for Dutch industry, "interfering decidedly with the latter's increasing ability to compete with many German products."

Argentina had in November assurance of large harvests, a circumstance which was affecting the general situation favourably. Confidence was growing, financial assistance had been voted for the State Railways, a number of public projects were in hand, and immigration (from Italy and Spain) was increasing.

Brazilian commerce and industries were affected by the instability of exchange, but the crop outlook was good and the rubber market was stronger. Credits had been approved for the purchase of railway equipment.

Conditions were favourable in Bolivia and a Government loan was contemplated for railroad construction.

In Italy there was a healthy economic situation. Investment of capital in industrial enterprises was increasing and most manufacturers reported increased demand for their products.

Cards of Trade Honour.—In the course of an article on "Unwarranted Contract Repudiation" (U.S. Commerce Reports), A. J. Wolfe, Chief of the Division of Commercial Laws, mentions the following interesting procedure: The export director of one of the foremost American international merchandising firms, in the wake of the wave of depression, stated that he had kept a record of his customers' attitude to their obligations on a card index consisting of white, grey, and black cards. On the white cards appear the names of those who honoured their signatures to a contract at all costs—and is it any wonder that the custom of those foreign houses is jealously guarded, that there is nothing in the way of accommodation they may ask for that would be denied them? On the grey cards are the names of those who, while having recourse to some slight delay, have in the end acted correctly—sometimes with a little extra help, but the record is none the less honourable, and credit would not be denied them, though it would be watched. But the black index is one where are found the names of those who took advantage of the situation to extort concessions by unwarranted complaints, by threats of repudiation, and by brazen defiance. It is a very comforting thought that in all countries and at all times there are found firms that belong on the white index; and it is a chastening thought that the black index is not free from the names of any nationality. A system, therefore, whereby the temptation to make unwarranted claims could be eliminated can only be welcomed. It must, adds the writer, be practical, economical, and equitable.

LIGHTING AND POWER NOTES.

Australia.—TWOFOLD BAY (N.S.W.).—A deputation from the Twofold Bay Development League is to wait upon the New South Wales Ministry to endeavour to secure the fulfilment of plans for an extensive hydro-electric scheme whereby the waters of the Snowy River would be harnessed. Plans for such a scheme have been prepared by the New South Wales chief electrical engineer. Provision is made for the erection of a power station and transmission line to Twofold Bay, a distance of eighty miles, at a cost of approximately £1,500,000. —*Reuter's Trade Service* (Melbourne).

Canada.—ONTARIO.—A new hydro-electric power company has been organised to furnish Northern Ontario gold mining industries with power and assist in the development of that territory. It is known as the Great Northern Power Co., Ltd. The company is now erecting the initial set of a plant (2,150 h.p.) on the Montreal River, near Indian Chutes, and it is expected that this will be in operation early in 1923.—*Reuter's Trade Service* (Toronto).

Chester.—LOAN SANCTIONED.—The Town Council has received from the Electricity Commissioners sanction to a loan of £54,000 for the purchase of the Government generating station at Queensferry, from which the Corporation has been receiving power.

Colne.—LOAN SANCTIONED.—The Corporation has received sanction from the Electricity Commissioners to the borrowing of £19,764 to cover capital expenditure incurred to August 31st last.

Continental.—FRANCE.—The Compagnie Lorraine d'Electricité, Nancy, has applied for a concession to supply electricity for light and power to 21 communes in the Syndicat Intercommunal de Méligny-le-Grand, department of the Meuse.

The Société Co-operative Agricole d'Electricité de la Région d'Hattencourt is applying for a concession to supply electricity in 23 rural communes in the Hattencourt district, Somme department. Another Société Co-opérative-Agricole is also applying for authority to supply electricity to 32 communes in the district of Montigny-sur-Hallue, in the same department.

Steps which have been taken to utilise the waters of the River Tinée, in the Canton of Nice, having proved successful, the Tinée Hydraulic Commission has reported favourably on the project to develop the Saint-Etienne Laos, Bancairon, and Corbaisse falls. The Société de l'Energie Electrique du Littoral Mediterranéen is to undertake the work.

The scheme proposed by MM. Lucien Neu and Louis Schwob, consulting engineers, of Enghien, for the utilisation of the River Doube for the generation of 2,500 kW for the city of Besancon has been adopted. The estimated cost of the scheme is 5,000,000 fr.

The Compagnie Parisienne de Distribution d'Electricité has recently brought into use a turbo-alternator of 30,000/35,000 kW at the Issy-les-Moulineaux station. This set is the first of a series of seven similar sets which form part of the extensions which were approved by the Paris City Council in 1921 and 1922, and will raise the total plant capacity of the company's stations to 350,000 kW.

GREECE.—It is announced that the Ministry of Communications is examining a scheme to utilise for various purposes the waterfalls of Macedonia and Western Greece which, it is estimated, would supply 500,000 h.p. It is believed that the Treasury would benefit by this scheme to the extent of 1,000,000,000 dr. annually.—*Reuter* (Athens).

Douglas (I. of M.).—ELECTRICITY SUPPLY.—The foundation stone has been laid of the new generating station. Two Ruston & Hornsby oil-driven engines of 300 h.p. each are being installed to drive dynamos of 250 kW each. Already about 120 applications for electricity have been received. Mains are being laid and a supply is expected to be available by May next.

Eastleigh and Bishopstoke.—ELECTRICITY SUPPLY.—The Urban Council has consented to the Southampton Corporation's application for a Special Order authorising it to supply electricity in the urban area.

Ebbw Vale.—LOAN SANCTIONED.—The Urban Council has received from the Electricity Commissioners sanction to a loan of £7,500 for electricity purposes.

Falkirk.—CHANGE-OVER OF SYSTEM.—The Corporation intends, subject to the consent of the Electricity Commissioners, to alter the system for the supply of electrical energy from d.c. at 460 V and 230 V to a.c., 50 cycles, at 440 V and 250 V, in a part of the burgh.

Great Yarmouth.—LOAN.—The Corporation has applied to the Electricity Commissioners for sanction to the borrowing of £5,500 for electricity purposes.

Guildford.—LOANS.—The Town Council has applied to the Electricity Commissioners for a loan of £20,000 for extensions to the electricity works, and the Commissioners have requested the Council to inform them of the amount of any tenders accepted in respect of the boiler-house plant, &c. The Commissioners have sanctioned loans of £5,850 for mains, distributors, and services, and £600 for meters.

Harrogate.—HIRE OF ELECTRIC COOKERS.—The Corporation has authorised the borough electrical engineer to purchase a number of electric cookers, to be hired out to consumers.

High Wycombe.—STREET LIGHTING.—The Town Council has entered into a new contract with the Electric Lighting and Power Co., Ltd., for public lighting for three and a half years at an annual standing charge of £700, plus 3d. per kWh up to 40,000 kWh per annum, and 2½d. beyond.

Irish Free State.—CASTLEREA (Co. ROSCOMMON).—The electricity undertaking of the Castlerea Electric Lighting Co., now in liquidation, has been purchased by three of the directors at a cost of £6,500.

Kingston-on-Thames.—LOAN.—The Town Council has decided to apply for a loan of £16,000 for a new turbo-alternator and other plant for the generating station.

London.—BARKING.—It is reported that work upon the new County of London Co.'s station at Barking will be commenced early in the present year. A contract for the foundation work has been secured by the Consolidated Construction Co.

STEPNEY.—*Price Reductions.*—As from the December meter readings the percentage advance upon the price of electricity for lighting is to be reduced from 33⅓ to 20. The advance of 25 per cent. upon power, heating, and private bulk supplies is to be reduced to 12½ per cent. In all cases meter rents will be reduced in the same proportion.

Maidstone.—PROPOSED BULK SUPPLY.—The Town Council has been approached by the Electricity Commissioners to ascertain whether it is possible for the Council to give a bulk supply of electricity to Ashford, 18 miles distant, instead of the Ashford Urban Council providing its own generating station, under an Order recently applied for.

New Zealand.—TARANAKI.—Government engineers are investigating a request made by the Egmont Power Board for a licence to develop 2,000 h.p. at Taranaki, on the west coast of the North Island. The estimated cost of the project is £60,000, and it is claimed that the scheme, which could be extended to 20,000 h.p., would be one of the cheapest in the Dominion.—*Reuter's Trade Service* (Melbourne).

Paisley.—YEAR'S WORKING.—The total revenue of the burgh's electricity undertaking for the year ended May 15th, 1922, was £85,014, as compared with £86,500 in the previous year. Working expenses totalled £48,913, as against £51,775, leaving a gross profit of £36,101. Capital charges, &c., absorbed £31,415, leaving a net profit of £4,686—greatly in excess of that of the previous year—£745. There was an increase in the amount of energy sold from 6,683,088 to 7,000,557 kWh, and the maximum demand rose from 3,800 to 4,150 kW. A total of £38,191 was spent on capital account; this was almost wholly expended on mains (£14,077) and transformers, &c. (£18,969).

Penybont.—ELECTRICITY SUPPLY.—The Penybont Rural District Council is applying to the Electricity Commissioners for powers to generate and distribute electrical energy within the parishes of Kenfig, Pyle, and Tythegston Higher, in the rural district of Penybont.

Sherborne.—SPECIAL ORDER.—Messrs. Crompton & Co. are making application to the Electricity Commissioners for a Special Order authorising themselves or a company to generate and supply electricity for all purposes within the urban district.

Stirling.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £5,700 for extensions to the electricity works and plant.

Walsall.—NEW PLANT.—The Electric Supply Committee has decided to install plant at a cost of £1,660 for the purpose of supplying power to a firm at Bloxwich which guaranteed a minimum consumption of £60 a quarter for five years.

Walthamstow.—EXTENSION OF SUPPLY.—The Urban Council is approaching the Woodford, Wanstead, Buckhurst Hill, Loughton, and Chigwell Councils with a view to supplying the districts with electricity.

Warrington.—CONSUMERS' GUIDES.—The Borough Electrical Engineer (Mr. F. V. L. Mathias) has sent us copies of a chart which is supplied to large consumers to enable them to calculate the cost per kWh of electricity supplied at various load and power factors. It consists of three vertical scales divided up according to power factor, cost per kWh, and load factor respectively. A straight line drawn from the power factor scale to the load factor scale intersects the centre scale at a point indicating the cost per kWh. A set of curves in which load factor is plotted against cost per unit for a fixed kVA charge, with a secondary "unit" charge, is also supplied.

West Ham.—LOAN.—The Town Council has applied for a loan of £6,915 for additions to the generating plant.

PRICE REDUCTIONS.—The Council has made the following reductions in the charges for electricity: Lighting, from 7d. to 6d. per kWh; power, from 1½d. to 1¼d.; heating, from 2d. to 1½d.; factory lighting, from 5d. to 4d.; theatres, music halls and kinemas, from 5d. to 4d. The discount on agreement supplies has been increased by 10 per cent.

(*Continued on page* 24.)

THE PIT RIVER 70,000-kVA HYDRO-ELECTRIC DEVELOPMENT.

Opening of the 200-mile, 220,000-volt Transmission System.

By FREDERICK A. TALBOT.

The Electrical Review recently described the construction of the new 220,000-volt transmission line of the Pacific Gas and Electric Co. for the conveyance of 70,000 kVA over the 200 miles separating the Pit River and Sacramento, and thence at 110,000 volts over the second stage of 100 miles to San Francisco. This line was opened for service on September 30th last, with the completion of the first two turbo-alternator sets installed in Pit River No. 1 power house. Thus was inaugurated a water-power development which, when carried to completion, will involve the passage of the water through seven successive power houses in the course of 60 miles, utilising a total head of 2,109 ft. and producing an aggregate of 450,000 kVA.

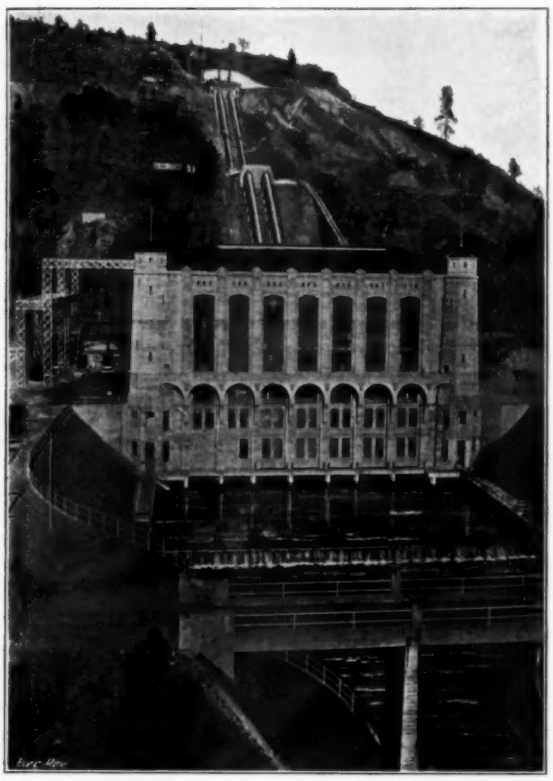


Fig. 1.—Pit River No. 1 Power House, showing Bridge, Weir, Stilling Basin, Penstocks, and Surge Chamber.

This scheme was adopted to rescue the State from the severe power shortage which was being experienced, and which reached a critical point during 1920. In that year the supply of electrical power fell below the demand to the extent of 100,000 h.p., owing to unprecedented drought. The outlook appeared so serious as to render it necessary for the authorities to institute drastic regulations for the distribution of electrical energy, petroleum, and natural gas throughout the State. Even then the loss experienced from the suspension of building operations, land development, and industrial activities was estimated to aggregate several millions sterling. The crisis induced the leading power corporations to push ahead with the big schemes which they had been considering tentatively, and to draw up a ten-year constructional schedule upon which they are working, of which the Pit River development represents the first instalment.

Notwithstanding the energy with which the various development schemes are being advanced, extreme difficulty is being experienced to keep supply in advance of demand, owing to the pace with which agricultural and industrial expansion is proceeding, which is aggravated by the persistent diminution of the petroleum yield.

It is for this reason that such feverish activity is being displayed to harness the 5,500,000 h.p. of hydraulic energy available in the State, of which, up to date, only a little more than 1,000,000 h.p. is being utilised. The initial development on the Pit River representing the use of 93,000 h.p., and the completion of two sets of plant on the adjacent Hat Creek having a combined installed capacity of 35,000 h.p., brought into operation last September, represents a total contribution of 126,500 h.p., which, so far as the Pacific Gas and Electric Co. is concerned, will enable supply to satisfy demand in the territory served. This company is the second largest electricity supply undertaking in point of volume of business in the United States. The territory served covers practically the whole of the great Sacramento Valley, the northern half of the San Joaquin Valley, and the metropolitan area around San Francisco Bay, service being furnished to 628,400 consumers of gas, electricity, and water, or a little more than one third of the total population of the area served. Its combined installed generating capacity, including the new initial development, aggregates 441,200 kW, while the total load connected to the system is nearly 1,100,000 h.p.

In the hydraulic sense the Pit River basin is eminently attractive, and the provision of storage reservoirs has been unnecessary. As a rule, work of this character has been unavoidably heavy with regard to Californian hydro-electric plant, and has reacted against the bringing-in of additional blocks of power with the celerity which demand has sought. The only storage work at

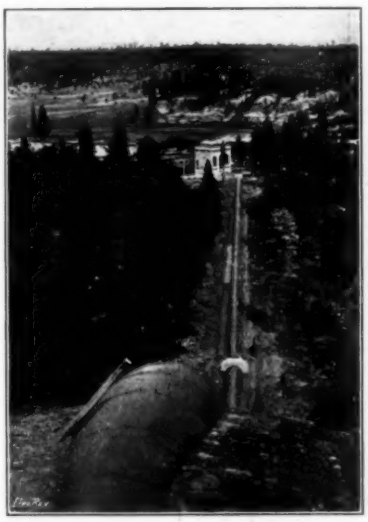


Fig. 2.—Hat Creek, No. 1, showing Penstock and Power House.

Fig. 3.—Hat Creek, No. 2 Power House.

present contemplated is for power house No. 3. This will be a diversion dam capable of creating a reservoir of 32,500 acre-feet capacity. Although this would be available to increase the low-water flow, it is probable that, if completed, it would be used as a forebay, to afford peak regulation, rendering possible the utilisation of the water through the three sets of plant lower down the river at a load factor of about 85 per cent.

FIG. 4.—PIT RIVER, No. 1; DIVERSION DAM, WITH RADIAL GATES IN FOREGROUND.

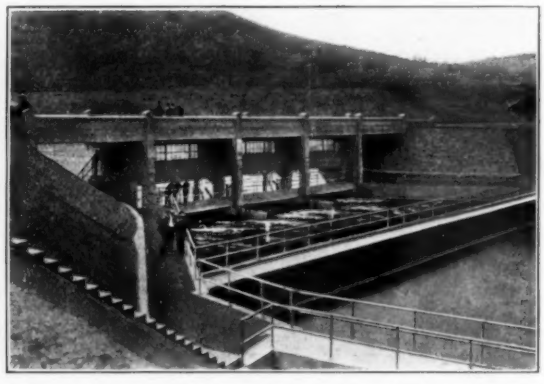


FIG. 5.—PIT RIVER, No. 1; INTAKE STRUCTURE AND HIGHWAY BRIDGE. TRASH SCREEN IN FOREGROUND.

It is the first of the two sets of plant located above this reservoir which has been completed, and is operating upon an average flow of about 1,400 second-feet from the Fall River. This initial installation, in addition to the Pit River plant No. 1, includes two smaller developments, each of 12,500 kVA, upon Hat Creek, which empties into the Pit River just below the site selected for Pit River No. 2 power house. These two sets of plant utilise substantially the whole of the drop from the creek to the confluence with the larger river. Hat Creek No. 1 station operates under a total head of 217 ft., receiving an average flow of 380 second-feet of water, mainly from the Riving Rising, whereas the second and lower plant, under a head of 201 ft., has its flow increased to 555 second-feet mainly by contributions from Crystal Lake.

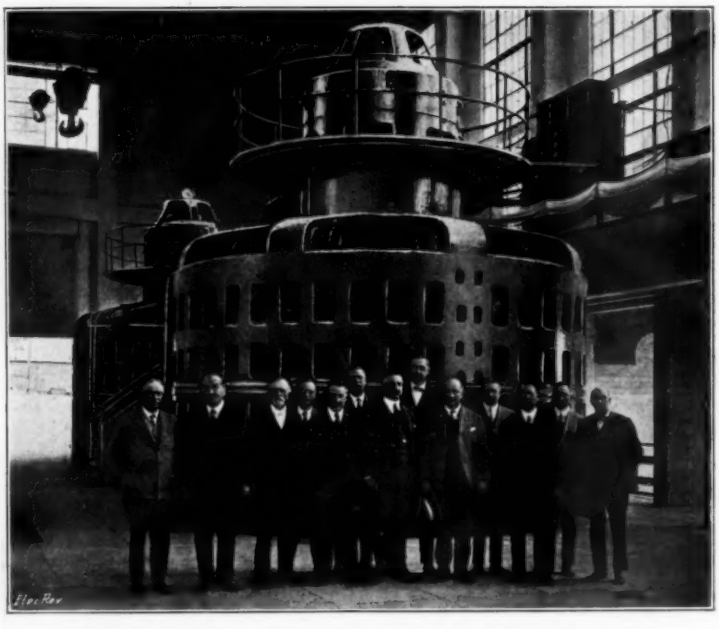


FIG. 6.—HYDRO-ELECTRIC GENERATING SETS, 35,000 kVA EACH.

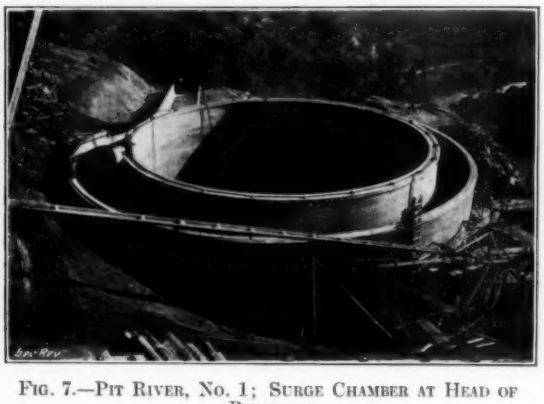


FIG. 7.—PIT RIVER, No. 1; SURGE CHAMBER AT HEAD OF PENSTOCKS.

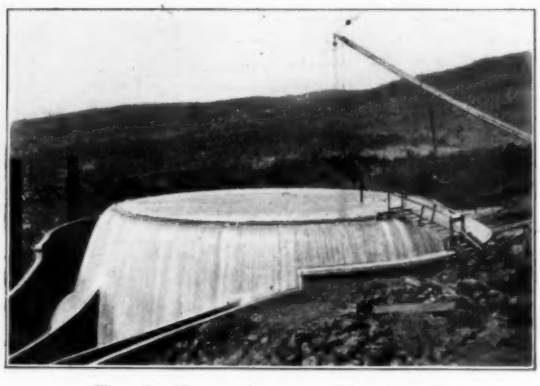


FIG. 8.—SURGE CHAMBER "SPILLING."

From the engineering point of view, the supreme difficulty in connection with the Pit River development was the remote situation of the site in the heart of the cascades, and its relative inaccessibility.

The Hat Creek sets of plant were the first to be completed. The upper station is 2,991 ft. above sea level, but the water diversion is at an altitude of 3,208½ ft. It comprises a timber and rock-filled crib dam carried diagonally across the stream to give the required 180-ft. length of spillway. The water is controlled by motor-operated radial gates, set in the concrete intake, which is connected to the forebay by an open ditch. The total capacity of the forebay, ditch, and reservoir is 50 acre-

feet. The water is carried to the power house through a steel penstock (fig. 2) 1,600 ft. long, having an average diameter of 108 in., the maximum drop from head water to tail water being 216.8 ft. The water is controlled by motor-operated radial gates at the forebay and an 80-in. butterfly valve at the power house.

The station houses a 15,000-h.p. vertical-shaft turbine, running at 225 r.p.m., connected direct to a 12,500-kVA, 3-phase, 6,600-volt generator, together with the necessary switchboard and control equipment. This plant is expected to develop a maximum of 8,600 kW when 600 second-feet of water is being delivered to the turbine, the effective head for this condition being 209 ft. Owing to the length of the penstock, it was necessary to install a 48-in. pressure regulator designed to discharge approximately 80 per cent. of the full flow.

Two miles below this station is the diversion for the second Hat Creek plant (fig. 3). A pile and timber structure is carried diagonally across the creek to give a spillway length of 282 ft. The water is carried from the diversion to the head of the penstock through a timber flume 4,469 ft. in length, resting on a bench excavated out of the mountain flank. This flume is of sufficient dimensions to carry 800 cu. ft. of water per second through a fall of 7 in. per 1,000 ft., and terminates in a combined flume, spillway, and header box of reinforced concrete. The last-named is built integrally with concrete collector flumes, and is so designed that water spills on both sides of the main flume, that is over two crests. The water spilling over the uphill crest is carried both ways towards the centre of the spillway, and there brought under the main flume to mingle with the water spilling over the down-hill crests, this being brought to the centre in a similar manner. The discharge to the river is through a concrete flume, the total capacity of the spillway being 900 cubic feet per second.

The penstock for this plant is of riveted steel. The maximum drop is 197 ft. 9 in. from forebay to tail water.

Fig. 11.—Outdoor Oil Circuit-Breakers for 220,000-V System.

Fig. 9.—Pit River, No. 1; Tail Canal and Bridge.

Fig. 10.—Tunnel Portal, showing Screen.

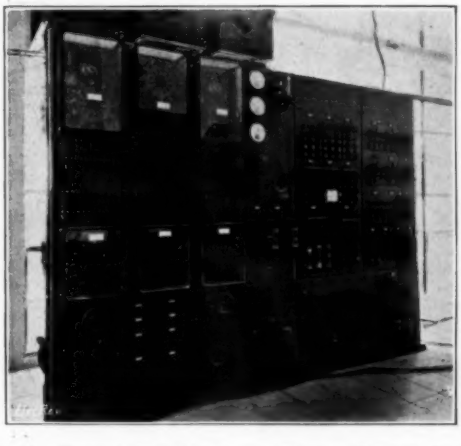


Fig. 12.—Tirrill Regulator and Station Service Panels.

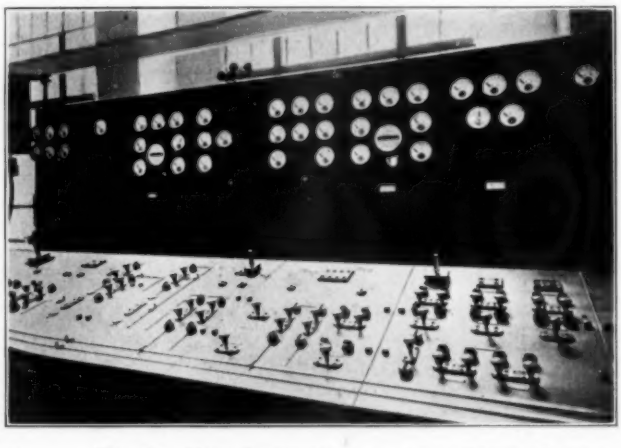


Fig. 13.—Main Switchboard in No. 1 Power Station.

Water control is effected by means of radial gates, as in the upper plant, but the pressure regulator is omitted owing to the short length of the penstock. The power house and equipment are practically a duplicate of the upper station, but owing to the inflow from Crystal Lake more power is available. The maximum power which will be developed in this station is 9,700 kW, with an effective head of 193 ft. 5 in. and a flow of 800 second-feet.

But it is the Pit River No. 1 plant (fig. 1) which is of the greatest interest, if only because the generating sets there installed are amongst the largest in the world, being second only to those recently placed in the Queenston station of the Hydro-Electric Power Commission of Ontario at Niagara.

The diversion for the station is on the Fall River, a tributory to the Pit, about one mile above the mountain town of Fall River Mills. The dam (fig. 4) is a concrete structure 14 ft. high by 500 ft. in length, and diverts water into the intake. Should the intake gates be closed for any reason, the water will automatically flow over the crest of the weir. Radial gates in the weir structure allow the entire flow of the river to be by-passed when the plant is not in use. The natural water-level of the river is not affected by this development to any greater extent than would be occasioned by the normal fluctuation.

The concrete intake is on the west side of the diversion dam, and has a wide flaring inlet from the Fall River. It contains three radial gates, and the structure is so-

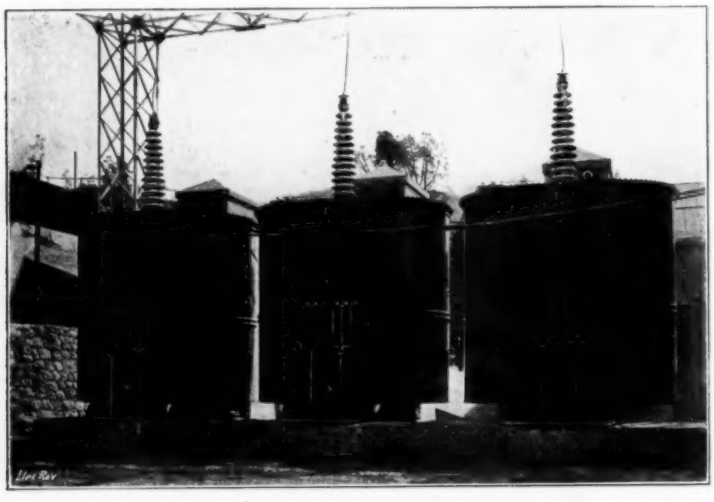


FIG. 14.—BANK OF 220,000-V WESTINGHOUSE TRANSFORMERS, 50,000 KVA.

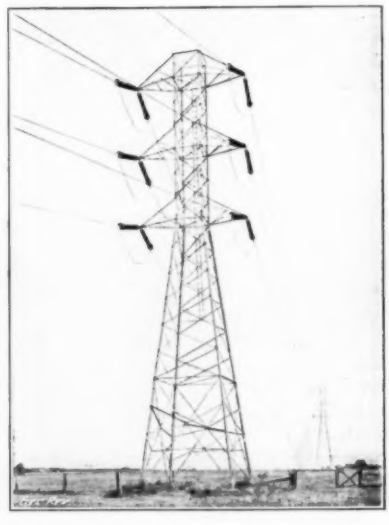


FIG. 15.—ANGLE TOWER ON 220,000-V LINE.

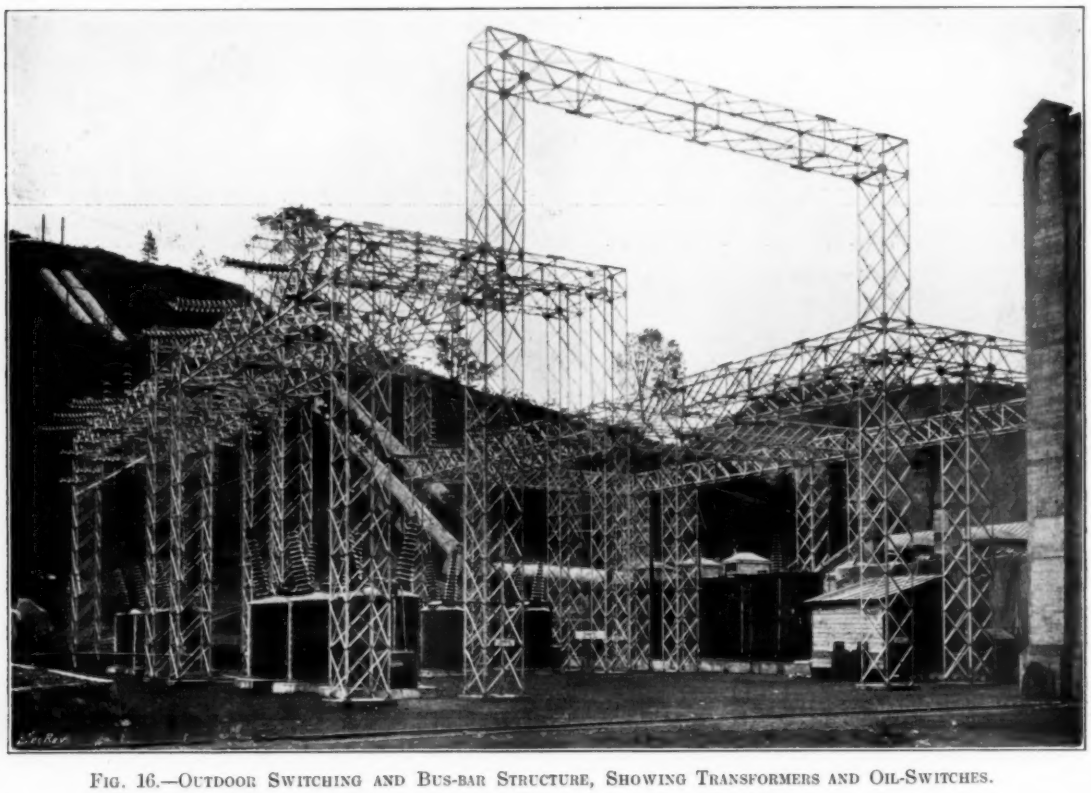


FIG. 16.—OUTDOOR SWITCHING AND BUS-BAR STRUCTURE, SHOWING TRANSFORMERS AND OIL-SWITCHES.

designed as to form a highway bridge over the canal (fig. 5). The water, before flowing through the gates, is first passed through a screen of steel bars. From the intake the water is led through an open canal 983 ft. in length and "rip-rapped" to prevent erosion, and designed to carry 1,800 cu. ft. per second, which is sufficient to carry the flow of the Fall River at all times of the year.

Between the intake and the power house rises Saddle Mountain, through which it was necessary to drive a tunnel for a distance of 10,160 ft. to carry 1,800 cu. ft. of water per second, terminating in a reinforced concrete spillway (fig. 7) and surge chamber, from which the two steel penstocks extend to the power house. The spillway (fig. 8) is designed to spill 1,800 second-feet in the event of a shut-down. An annular-shaped collecting conduit passes round the surge chamber to spill the water through the discharge canal or raceway over the cliff into the Pit River below. The surge chamber is fitted with three sluice pipes to facilitate the removal of mud or *débris* that may collect in the bottom.

Two penstock lines, one for each machine, lead from the surge chamber to the power house. The diameter of each at the upper end is 129 in., tapering to 105 in. at the lower end. At each end butterfly valves are fitted, those at the surge chamber end being the largest yet constructed. The penstock lines, each 1,357 ft. in length, are built in two sections. The upper end, for a distance of 330 ft., is of the usual riveted steel construction, but for the lower 1,027-ft. Kellogg pipe with forge-welded longitudinal seams was used. The lines are laid on the surface of the mountain side, supported on concrete piers, and secured at seven points by concrete anchors. Two tunnels, each 185 ft. in length, have been driven from the turbines under the switch-house building to the toe of the mountain, so that the water is led into the station underground. In successive stages the hydro-cone tables, concrete draft tubes, and other features were formed and concreted, while the machinery was installed before the delivery of the frame steel for the building so as not to retard the completion of the work. The building proper was carried out during the winter despite the low temperature; the snow had frequently to be cleared from the working area.

The power house contains two 40,000-h.p. single-runner, vertical-shaft, hydraulic turbines (fig. 6), each connected directly to a 35,000-kVA, 90 per cent. power factor lagging, 11,000-volt, 3-phase, 60-cycle generator running at 257 r.p.m. The selection of this size of set was dependent to a large extent on the charging current required for the 200,000-volt transmission line. The sets are complete with integral oil-pressure governors and directly-connected fly-balls, lifting jacks, air-operated braking mechanism, and telescopic draft tubes. The excitation is furnished by 250-volt exciters connected directly to each of the main sets. For emergency a 225-kW motor generator exciter set is connected to a 440-r.p.m. single-jet overhung impulse turbine operating under an effective head of 400 ft. The maximum output of the station is 53,500 kW obtained with a flow of 1,800 second-feet, and an effective head of 418 ft.

The whole of the heavy low-pressure switching equipment is arranged in the lower rear wing of the building behind the generators, while an elevated switchboard gallery is provided along the down-stream wall of the main building. The high-pressure switchgear, fig. 16, is placed out of doors, on concrete foundations, with convenient track connections into the building, within easy reach of the power-house cranes. The oil circuit breakers (fig. 11) are of the Westinghouse 220,000-volt, 400 amperes, earthed-neutral, outdoor type with a rupturing capacity of 2,400 amperes at 220,000 volts.

Briefly described, the transmission scheme which has been adopted is as follows:—A bank of three 4,000-kVA, 6,600/60,000-volt transformers is installed at each of the Hat Creek power houses, and the power from these stations is transmitted at 60,000 volts to Pit station No. 1, where both the Hat Creek lines feed into one bank of 8,000 kVA, 60,000/11,000-volt transformers, the low-voltage windings of which are connected to the 11,000-volt bus-bar. The Pit. No. 1 generators are also connected to this bus, and the combined power is fed into two banks of 16,667 kVA, 11,000/220,000-volt transformers for transmission to the Vaca-Dixon sub-station, 202 miles to the south (fig. 14).

The transmission lines are for the most part carried on steel towers (fig. 15), the single-circuit "Snow" type of tower being used in the mountains from Pit No. 1 to Cottonwood, and the twin circuit single tower from Cottonwood to Vaca-Dixon. For the first 28 miles from the generating station steel-cored aluminium cable, 1 in. in diameter, is utilised, having a conductance equivalent to 325,000 circular mils of copper. For the remaining 175 miles 500,000 circular mils, 7 × 7 copper cable is used, composed of 49 individual strands of medium hard-drawn copper, each strand being 0.101 in. in diameter.

The insulators used have probably received more study and investigation than any other single feature of the Pit No. 1 development. The staffs of the laboratories of several of the insulator manufacturers, as well as that at Stanford University, have conducted investigations, all of which have not as yet been completed. It has, therefore, been decided to operate the lines at 175,000 volts or less at first, so that advantage may be taken of any improvements in insulator design resulting from these researches in making the final selection of the insulators for 220,000-volt operation.

The string adopted for present operation at 175,000 volts consists of 13 cap and pin insulators, the first nine of which are "Standard," 10 in. in diameter, the next four "Special," two being 11½ in. and the other two 13½ in. in diameter. There is also a "Standard" 10-in. one at the bottom enclosed in a copper envelope 16 in. in diameter to fulfil a two-fold purpose. It acts as a shield to prevent the formation of corona and, in addition, serves as a splash plate, by means of which the lower side of the insulator above it will become wetted, and thus tend toward a uniform condition of the string as to moisture. This corona shield does not possess insulating quality; the insulator enclosed within it merely serves as a convenient method of retaining the shield in its proper position with respect to the remainder of the string.

Four miles out of Vacaville, in the Sacramento Valley, is the southern terminal of the transmission line, the Vaca-Dixon sub-station. It serves two purposes: first, it includes two banks of transformers for stepping down the Pit River power from 220,000 to the 110,000 volts standard of the general high-pressure transmission of the company, at which it is transmitted to San Francisco; secondly, the sub-station building houses the two synchronous condensers whose function is to regulate the line voltage and thus increase the transmission capacity.

There are seven transformers disposed in two banks of three each, the seventh acting as a spare, single phase and of 16,667 kVA capacity. In addition to transforming from 200,000 volts, acting as auto-transformers, they are equipped with straight low-voltage windings of 3,300 and 11,000 volts to be used in the starting and running of the condensers respectively. Three oil switches similar to those at Pit No. 1 station are provided, together with air disconnectors, for the control of the different circuits. The above equipment, with the exception of the two condensers, is installed out of doors.

The two synchronous condensers are 20,000-kVA, 11,000-volt, 3-phase, 60-cycle, 600-r.p.m., horizontal revolving-field, synchronous machines with 110-kW, 250-volt, direct-connected exciters.

Both at Pit River and at Vaca-Dixon a garden village has been built for the accommodation of the operators, that at the former station being carried out in the Swiss châlet style. With the exception of the intake canal, tunnel, and tailrace, the whole of the work, including the construction of the 34 miles of standard-gauge railway, was carried out by the constructional organisation of the Pacific Gas and Electric Co., under the direction of vice-president A. H. Markwart, in charge of engineering.

LIGHTING AND POWER NOTES.

(*Continued from page* 18.)

Whitstable.—PLANT EXTENSIONS.—The Electric Light Co., Ltd., has decided to increase its borrowing power from £10,000 to £20,000 in order to extend the plant. When the new plant is completed the present generating capacity will be more than trebled, making it sufficient to cover all the requirements of the company during the next ten years.

West of Scotland Electricity District.—EXTENSION OF TIME.—The Electricity Commissioners give notice that the time within which objections or representations may be made, and schemes for the reorganisation of the supply of electricity in the above-named area may be submitted, has been extended from December 30th, 1922, to June 30th, 1923.

TRAMWAY AND RAILWAY NOTES.

Bingley.—EXTENSION OF TIME.—The Town Council has received sanction for the time limit for the completion of the tramway route from the terminus at Cross Flats to the district boundary, along Keighley Road, to be extended for 12 months from February 7th next.

Birkenhead.—PARLIAMENTARY BILL.—The Corporation is promoting a Bill in Parliament, empowering it to construct tramways linking up the Laird Street and Ilchester Road routes.

Bradford.—NEW CARS.—The first of the six new one-man railless trolley cars now in course of construction for the Bradford Corporation was given a trial run on December 28th on the Bankfoot-Bolton route of the railless car system. The cars are built to the design of Mr. R. H. Wilkinson, the general manager of the tramways, and are constructed at the department's Thornbury depôt. There is seating accommodation for 30 persons, in two compartments, one of which is for smokers. The first of the new cars came into commission for public use on January 1st on the Bankfoot-Bolton route.

Coatbridge.—NEW TRACK.—The Glasgow Corporation is to proceed with the doubling of the tramway track on the system between Coatbridge and Airdrie.

Continental.—SWITZERLAND.—It is anticipated that the construction of the Centovallina railway, which will run from Locarno to Domodossola in Italy, will be completed in a few months. This line will afford direct communication between Western Switzerland and Italy across the Simplon. The last of the 50 bridges has been completed, the stations are ready, the rails are mostly laid, and the rolling stock is on order. The Italian Government has granted big customs and police facilities on traffic over Italian soil. The journey from Berne, Interlaken, Lucerne, and Locarno will take five or six hours, instead of ten as formerly.

Exeter.—PENNY FARES.—The Town Council has introduced penny fares on the tramway system.

Keighley.—LINKING-UP OF TRAMWAYS.—The Town Council has invited representatives of the Bradford Tramways Committee and other bodies concerned to attend a conference to discuss the possibility of linking up the Bradford and Keighley tramway systems at Bingley.

Leeds.—LIGHT RAILWAYS.—The Corporation is applying to the Minister of Transport for authority to construct and work light railways in the city and rural district of Hunslet, in the West Riding of Yorkshire.

United States.—ILLINOIS.—According to the *Railway Gazette*, a joint Commission appointed two years ago by the Illinois Central Railroad and the city of Chicago has recommended that in the electrification of that line, the 1,500-V, d.c. overhead system should be adopted. According to the agreement, the suburban passenger service is to be electrically operated by 1927, and the whole of the freight service within the city by 1935.

TELEGRAPH & TELEPHONE NOTES.

France.—THE TELEPHONE SERVICE.—In the French Chamber on December 23rd an amendment by the Deputy, M. Lambert, to authorise the telephone service being transferred from the Government to private hands, was rejected by 397 votes to 170. The Postmaster-General declared that such an amendment, if passed, would lead to gross abuse on the part of speculators.—*Financier.*

PRIVATE RADIO INSTALLATIONS.—The French Under-Secretary for Posts and Telegraphs recently stated that about fifty thousand private radio installations were in use in France.

CABLES.—The Chamber, on December 27th, continued the discussion of the Posts, Telegraphs, and Telephones Budget. The Under-Secretary of State of the P.T.T. said that State cables would not be ceded to private companies. With regard to the Brest-Dakar-Pernambuco cables, it was stated that the prolongation of the Dakar-Pernambuco line in South America was being investigated. It had not yet been decided whether this new line would be developed by the State or by a private company, and the question would be settled by Parliament. With regard to the request made by M. Loucheur for the reconstruction of the Paris-London, Paris-Strasbourg, Paris-Lille, Paris-Marseilles, Bordeaux, &c., cables, the Under-Secretary stated that his suggestions were to be carried out. The Post Office estimates were adopted by the Chamber.—*Reuter.*

Pacific Cable Board.—YEAR'S WORKING.—The Treasury has issued the report of the Pacific Cable Board for the year ended March 31st, 1922, showing that the receipts for that period exceeded the ordinary expenses by £210,257. From that amount a special contribution of £100,000 was made to the reserve and renewal fund for cable duplication. On revenue account the traffic receipts are given at £521,643, which total fell short by £98,409 compared with the previous year. This was the result largely of the reinstatement of cheap services, notably week-end telegrams.—*Financial Times.*

NEW CABLES.—The Board has recently placed a contract with the Telegraph Construction and Maintenance Co. for the laying of cables between Suva (Fiji) and Auckland (N.Z.)—a distance of over 1,300 nautical miles; and between Southport (Queensland) and Sydney (N.S.W.)—about 540 nautical miles. The cable steamer *Colonia* will lay the cables by August next, it is hoped.

According to the *Evening News*, the scheme represents the first instalment of the policy of duplicating the Pacific cable. It involves an outlay of between £250,000 and £500,000. The longer section—that from Bamfield to Fanning Island—is to be taken in hand later. Important experiments by the Telegraph Construction and Maintenance Co. have been so far successful that a new and improved type of cable will, it is believed, be perfected in the near future. This promises such a gain in handling the traffic that the Board is awaiting the result of further tests before making a decision whether the duplicate Fanning Island to Bamfield cable shall be of the type of those now ordered or the new one.

The Telephone Service.—BURNLEY.—A sub-committee of the Town Council, after inspecting the local telephone exchange, has reported that no great improvement in the service could be expected until the exchange was removed to more commodious premises. The report added that it was understood that the proposed removal of the exchange to premises adjoining the Post Office would probably take place in about two years' time. It was decided to ask the Postmaster-General to expedite the work.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia. — MELBOURNE. — Postmaster-General's Department.—January 8th. Operators' calling devices. January 11th. Switchboard cable. January 17th. Telephone and telegraph apparatus. January 24th. Testing and telegraph instruments. February 22nd. Switchboard parts. March 1st. Telephone and telegraph parts. (December 22nd.)

March 31st. Electricity Commissioners. Transformers for Morwell power scheme. (See this issue.)

SYDNEY.—January 29th. Municipal Council. Feeder protective apparatus for sub-stations.*

PERTH (W.A.).—March 1st. Government Tender Board. L.p. switchgear.*

Belfast.—January 23rd. Electricity Department. One 12,500-kW turbo-alternator, with condensing plant and auxiliaries, three 500-kW rotary converters with transformers, l.p. switchgear, &c. (See this issue.)

Belgium.—January 20th. Municipal authorities of Saint-Gilles-lez-Bruxelles. 400 3-amp., 220-V, d.i. meters and 1,200 5-amp. ditto. Service de l'Electricité, 40, Rue de Bethléem, Saint Gilles, Brussels.

January 8th. The municipal authorities of Zondhoven (Province of Limbourg) are inviting tenders for the concession for the establishing of an electricity supply system in the town.

Belgian Congo.—The Belgian Ministry of the Colonies, in Brussels. Miscellaneous material in connection with the telegraph and telephone lines in the Belgian Congo.

Brazil.—The Brazilian Consulate in Brusseis, 201, Rue Royale, announces that the authorities of the State of Rio Grande are inviting tenders for the supply of a number of electrically-operated cranes.

China.—HANKOW.—January 15th. Hankow Waterworks and Electric Light Co. Equipment of a 3,750-kVA power plant. Specifications from the company's head office, Hankow.—U.S. *Commerce Reports.*

Dundee.—January 19th. Electricity Department. House service meters. (See this issue.)

Egypt.—ALEXANDRIA.—January 17th. Ports and Lighthouses Administration. Stores, including electrical goods, for 12 months.*

CAIRO.—March 15th. Minister of the Interior. Supply of electrical fittings for 12 months. Director, Personal and Equipment Department, Minister of the Interior, Cairo.—*Reuter's Trade Service* (Cairo).

France.—FRANCHEVAL.—Plans are being considered for an electrical installation in the commune of Francheval (Ardennes). Particulars from the Mairie.

An electrification project is under consideration at Paray-le-Monial (Sâone-et-Loire). For details apply to the Mairie.

Electrical installation at Le Vigan (Gard). Particulars from the Mairie.—*Reuter's Trade Service* (Paris).

Holmfirth.—January 29th. Urban District Council. Electric lighting scheme. Erection of buildings; plant, including oil engine-driven dynamo, motor booster, switchboard, accumulators, overhead traveller, &c.; overhead mains, house services, &c. (See this issue.)

Leeds.—January 11th. Board of Guardians. Installation of electric light in blocks 5 and 6 of the institution, also church and clock tower in Beckett Street. Mr. J. H. Ford, clerk to Guardians, Poor Law Offices, South Parade, Leeds.

London.—CAMBERWELL, S.E.—February 5th. Borough Council. Maintenance of private telephones and electric bells at the Town Hall and other public buildings for 12 months. Mr. F. J. Slater, borough engineer, Town Hall.

BERMONDSEY.—January 29th. Electricity Department. Stores for six months, including cable and jointing material, conduits, meters, electrical accessories, &c. (See this issue.)

ISLINGTON.—January 31st. Electricity Department. Electrical and engineer's stores for 12 months, including cables, meters, transformers, electrical sundries, &c. (See this issue.)

Manchester.—January 9th. Tramways Committee. Steel tramway poles. Mr. Henry Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

Trafford Park Estates, Ltd. Reconstruction of the permanent way of the electric tramway in Trafford Park. Secretary, Estate Office, Trafford Park, Manchester.

Newport.—January 22nd. Electricity Department. One marine water-tube type boiler, with superheater, economiser, stokers, steam and feed-water pipes, &c. (See this issue.)

New Zealand.—INVERCARGILL.—January 31st. Southland Electric Power Board. Outdoor transformer station equipment for the Monowai hydro-electric development scheme.*

South Africa.—CAPE TOWN.—January 12th. City Council. 10,300 yd. h.p. and l.p. cable; three 150-kVA single-phase transformers; four 100-kVA ditto; three 40-kVA ditto.*

Stoke-on-Trent.—January 10th. Electricity Department. Neutral earthing resistance. Twelve months' supply of static transformers, and sub-station switchgear. (December 29th.)

Uruguay.—MONTE VIDEO.—February 15th. State Electricity Works. 16,000 metres of coloured cords for internal wiring.*

February 9th. 27,750 metres of 225-V, v.i.r. lead-covered cable.*

Walsall.—January 11th. Board of Guardians. Installation of electric light at the Union infirmary, Pleck Road. Mr. A. H. Lewis, clerk to Guardians, 29, Leicester Street, Walsall.

*A copy of the plan, specification, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—SYDNEY.—Electricity Supply Committee. Recommended :—

L.p. insulators (£3,844).—W. G. Watson & Co., Ltd.
Electricity meters, "A" section: D.c. meters (£5,767).—Noyes Bros., for Ferranti Meters.
"B" section: Single-phase a.c. meters (£42,936).—Noyes Bros.
"C" section: A.c. polyphase meters (£242).—Met.-Vickers Elec. Manfg. Co., Ltd.

BANKSTOWN (N.S.W.).—Municipal Council. Accepted :—

Transformers.—General Trading Co.
Poles, street lighting fittings, copper conductors, outdoor transformer sub-stations, and consumers' services.—Lawrence & Hanson Electrical Co.
Feeder and street lighting panels, time switches.—British General Electric Co., Ltd.
Lightning arresters and recording instruments.—Australian General Electric Co.
Lamps.—De Wolf & Vale.

STAWELL (VIC.).—Municipal Council. Accepted :—

Power plant and auxiliaries (£4,160).—Kynochs, Ltd.
Alternators (£635).—Australian General Electric Co.
Wires and cables (£1,591).—British Insulated & Helsby Cables, Ltd.
Meters (£730).—Strachan, Murray & Shannon. *Tenders.*

Hull.—The Tramways Committee has recommended the acceptance of a Belgian tender for 1,000 tons of tramway rails at £9,547. The English tender was £14,330.

Leeds.
Electrical installation at the new premises of the *Yorkshire Evening News*.—Cloke Extension, Ltd.

London.—PADDINGTON.—Borough Council. Accepted :—
Maintenance of the electrical installation and fire alarms at the Town Hall for three years.—Cunningham, Ltd.

STEPNEY.—Electricity Committee.
¼ mile 3-in. earthenware pipes (£58); ¼ mile 3-way 4-in. earthenware conduits (£117); ¼ mile "B" troughs and cover work (£88).—Sutton and Co. (Overseal), Ltd. (Accepted.)
100-50-amp. combined fuse-boxes and troughs (3 core) (£80); 500-25-amp. bridge-type fuse-boxes (£96).—W. T. Henley's Telegraph Works Co., Ltd. (Accepted.)
Copper tape and rod (£137).—T. W. Young, Ltd (Accepted.)
Two cast-iron strainer boxes for turbine, Limehouse generating station (£90).—Caird & Rayner, Ltd. (Recommended.)

Maldon.—Urban Council. Accepted:—
Installin electric light in the municipal offices.—F. Leatherbell.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—JUVENILE CHRISTMAS LECTURES.—At 21, Albemarle Street, W. At 3 p.m. On "Six Steps up the Ladder to the Stars," by Prof H. H. Turner, F.R.S.
Saturday, January 6th, "Two Great Streams of Stars" (Lecture V).
Tuesday, January 9th, "The Size of a Star" (Lecture VI).

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, January 8th. At the Institution, Victoria Embankment, W.C.2. At 7 p.m. Discussion on "The Protection of Invention by Letters Patent," to be opened by Mr. E. W. Moss.

(South-Midland Centre).—Wednesday, January 10th. At the University, Birmingham. At 7 p.m. Paper on "Technical Research, with special reference to Electrical Engineering Development," by Mr. W. Wilson.

(North-Eastern Centre).—Monday, January 8th. At Armstrong College, Newcastle-on-Tyne. At 7.30 p.m. Visit and address by President, Mr. F. Gill.

(North-Western Centre).—Tuesday, January 9th. At the Engineers' Club, Manchester. At 7 p.m. Lecture on "Electricity in the Home," by Mr. J. W. Beauchamp.

(Scottish Centre).—Tuesday, January 9th. At the North British Station Hotel, Edinburgh. At 7 p.m. Paper on "Domestic Load Building," by Mr. W. A. Gillott.

(Students' Section).—Friday, January 12th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Air-driven Electric Generators," by Mr. W. Stirling.

(Dundee Sub-Centre).—Thursday, January 11th. At the University College, Dundee. At 7.30 p.m. Paper on "A Modern C.B. Telephone Exchange," by Mr. R. J. Lawson and Mr. S. D. Cawood.

(East-Midland Sub-Centre).—Tuesday, January 9th. At the University College, Nottingham. At 7 p.m. Paper on "Starters and Controllers for Electric Motors," by Mr. O. C. Dinerman.

(Wireless Section).—Wednesday, January 10th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Design of Radio Towers and Masts: Wind-Pressure Assumptions," by Mr. C. F. Elwell.

National Association of Supervising Electricians.—Tuesday, January 9th. At St. Bride's Institute, Ludgate Circus, E.C. At 6.45 p.m. Lecture on "Electric Lifts," by Mr. H. Marryat.

Paisley Association of Electrical Engineers.—Tuesday, January 9th. At 99, High Street. At 7.30 p.m. Ordinary meeting.

Institute of Marine Engineers.—Tuesday, January 9th. At the Institute, The Minories, E. At 6.30 p.m. Paper on "Gas Engines and Gas-producer Plants," by Mr. H. Campbell.

Electrical Society of Glasgow.—Tuesday, January 9th. Paper on "The Problem of the Small Consumer," by Mr. D. Berry.

Greenock Electrical Society.—Wednesday, January 10th. At 22, West Stewart Street. At 7.45 p.m. Paper on "Rotary Converters," by Mr. P. C. Kerr.

Institution of Civil Engineers.—Tuesday, January 9th. At the Institution, Great George Street, S.W. At 6 p.m. Paper on "Twelve Years' Operation of Electric Traction on the London, Brighton & South Coast Railway," by Mr. H. W. H. Richards.

Institution of Automobile Engineers.—Wednesday, January 10th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. Paper on "Railless Trolley Traction," by Mr. C. W. J. Taffs.

Electro-Harmonic Society.—Wednesday, January 10th. At the Caxton Hall, Westminster, S.W. At 8 p.m. Smoking concert.

Association of Engineers-in-Charge.—Wednesday, January 10th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Paper on "The Selection of Fans and their Application," by Mr. A. Fleming Browne.

Chief Technical Assistants' Association.—Thursday, January 11th. Discussion on "A Mains Problem," to be opened by Mr. E. R. Ingram.

Chelmsford Engineering Society.—Thursday, January 11th. At the East Anglian Institute of Agriculture. At 7 p.m. Students' meeting.

Junior Institution of Engineers.—Friday, January 12th. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Transient Phenomena Arising in Transformers from Switching Operations," by Mr. S. A. Stigant.

Edinburgh Electrical Society.—Friday, January 12th. At the Philosophical Institute. At 8 p.m. Paper, "Some Wireless Notes," by Mr. A. Whiteley.

Institution of Heating and Ventilating Engineers.—Friday, January 12th. At the Engineers' Club, W. At 7 p.m. Paper on "Automatic Temperature Control," by Mr. B. R. Wingfield.

Association of Mining Electrical Engineers.—LOTHIANS BRANCH.—Saturday, January 13th. At the Heriot Watt College, Edinburgh. Questions and answers.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

WE have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following devices are asked for :—

ORSOVA reflectors for electric street lamps.
EDISON electric pen (a reader desires to secure one).
SIMPLICITAS switches.
A heating system for buildings, factories, &c., which is entirely controlled by thermostats.
WOOLSTAN geared pump.
MESCO snap switches.
WHITE CROSS electric vibrator.

NOTES.

Street Lamp Thieves.—According to a Petrograd newspaper, for reasons of economy the streets in that city are only fully lighted at 9 p.m., when the bandits make their appearance in the streets. As there is a scarcity of electric lamps, the thieves make a speciality of appropriating those used for street lighting, and every night a few hundred lamps are said to disappear in this way without the "militie" having so far been able to seize a single lamp thief. If the thefts continue as hitherto, the newspaper says that the streets will soon be plunged into darkness.

Electro-Harmonic Society.—The next smoking concert will be held in the Caxton Hall, Westminster, on Wednesday next, January 10th, at 8 p.m. Mr. Archibald Page, M.I.E.E. (Member of H.M. Electricity Commission), will preside. The artistes will be:—Miss Marion Browne, soprano; Miss Lucie Flanders, contralto; Mr. Edward Halland, basso; Miss Edith Penville, solo flautist; Mr. Emil Clare, humorist; Mr. Walter Montagu, entertainer; Miss Traybon, entertainer at piano; Mr. Bernard Flanders, solo pianoforte.

Appointments Vacant.—Consumers' engineer, for the Portsmouth Corporation electricity department; boiler-house superintendent, for the Halifax Corporation electricity department. (See our advertisement columns to-day.)

The Electrical Engineers' Ball.—This most enjoyable annual event is fixed for January 26th, and it will be held at the Hotel Cecil. The following is a list of the members of the General Committee and of the Executive Committee. Messrs. A. M. Sillar and W. Stanley Lonsdale are again acting as hon. secretaries, and Mr. J. E. Kingsbury as hon. treasurer.

GENERAL COMMITTEE.

Addenbrooke, G. L.	McKay, H. T. S.
Alabaster, H.	McMahon, P. V.
Allcock, H.	Madgen, W. L.
Andrews, Leonard	Matthews, W. Lee
Atkinson, Ll. B.	Mordey, W. M.
Baldwin, O. H.	Moss, E. W.
Balfour, George, M.P.	Nalder, F. H.
Bowden, J. H.	Noble, Sir Wm.
Byng, E. G.	O'Brien, Col. H. E., D.S.O.
Callender, Sir T. O., J.P.	O'Meara, Col. W. A. J.
Chattock, R. A.	Partridge, G. W.
Cramb, A. C.	Petersen, T.
Cridge, A. J.	Pooley, F.
Crinks, P. F.	Purves, Major T. F.
Couzens, H. W.	Pybus, P. J., C.B.E.
Devonshire, Sir James L., K.B.E.	Railing, M. J.
	Rider, J. H.
Elder, T. C.	Roberts, M. F.
Fairman, H. W.	Robinson, L. L.
Ferranti, Dr. S. Z. de	Rowell, P. F.
Fox, E. J.	Rutherford, W.
Gatehouse, E. A.	Sayer, C. E.
Geipel, K.	Scholey, H., C.B.E.
Gill, Frank	Sharp, Sidney
Gray, James	Siddeley, H. C.
Gregory, J. P.	Sillar, A. M.
Hadley, A. E.	Snell, Sir John
Highfield, J. S.	Sparks, C. P., C.B.E.
Hill, C. W.	Sparks, Col. H. C., C.M.G., D.S.O.
Hirst, Hugo	
Hunter, P. V., C.B.E.	Sutton, Sir George, Bt.
Hughman, R. W.	Taite, C. D.
Kemnal, Sir James, K.B.E.	Taylor, Capt. G.
Kerr, Major D.	Taylor, James, J.P.
Kingsbury, J. E.	Trezise, J. M. G.
Leaf, H. M.	Wallis-Jones, Capt. R. J.
Leigh, Lt.-Col. F. A. Cortez	Walton, A. H.
Lonsdale, W. Stanley	Wilson, David
McGregor, J. J., C.B.E.	Wordingham, C. H., C.B.E.

EXECUTIVE COMMITTEE.

O. H. Baldwin	J. E. Kingsbury
W. Stanley Lonsdale	P. V. McMahon
A. M. Sillar	C. H. Wordingham, C.B.E.
Capt. R. J. Wallis-Jones	A. H. Walton.

Institution of Production Engineers.—A general meeting of the Institution will be held at 7.30 p.m. on January 4th, at the Engineers' Club, Coventry Street, W.1. On this occasion, Mr. J. Moore, chief jig and tool draughtsman of the Associated Equipment Co., Ltd., of Walthamstow, will read a paper, to be illustrated with lantern slides, dealing with "Jigs and Tools."

Scientific Novelties Exhibition.—As mentioned in our last issue, an exhibition of "Scientific Novelties" is being held at King's College, Strand, up to January 10th, in aid of the London hospitals. It was opened by Viscount Burnham on December 28th.

Many demonstrations of phenomena, instructive, fascinating, and amusing, have been arranged by the colleges, institutes, and polytechnics of London. In the engineering section, electric welding is performed by the Alloy Welding Processes, Ltd., and the Electric Welding Co., Ltd., and a number of welded articles and apparatus are shown. Messrs. Siemens Bros. & Co., Ltd., show a section of a 10,000-line automatic exchange, similar to exchanges they are supplying to South Africa and Canada. A number of instruments are connected up to this and the sequence followed by the various selectors is open to view; they can be operated by visitors. Different audible warnings are given when a line is engaged or out of order. A special feature of the system is the delayed metering device which allows ample time for a call to be answered before it is recorded on the meter connected to each number. Experiments with electric arcs are made by students of the College under Prof. E. Wilson. These include boiling metals in a vertical carbon arc. The measurement of light is demonstrated by means of a lumen meter cube and a lumen comparator—the latter containing a standard lamp, the voltage of which is varied by a sliding resistance enabling it to be reduced in intensity to equal that of an inferior lamp, when by means of curves the intensity of the latter lamp can be worked out. The effects of capacity and inductance in an oscillating circuit are demonstrated by a musical method; the closing of Morse keys cuts out or puts in capacity and varies the pitch of the note obtained. Prof. McGregor Morris's hot-wire anemometer is shown. The reception of radio telegraphy has been arranged by Prof. C. L. Fortescue, O.B.E., with the assistance of the Western Electric Co., and the King's College Wireless Society.

A wide variety of demonstrations is to be seen in the physics section, most of which are familiar to the engineer but miraculous to the public. A particularly beautiful display is a demonstration of cathode-ray tubes arranged by the Regent Street Polytechnic under Mr. D. Humphrey, B.A. This takes place in a darkened room and the tubes are equipped with floral designs, &c., in many colours.

Among the many other experiments are those showing the effect of light of various colours on selenium and the variation of the resistance of bismuth in a magnetic field. In the biological section are shown instruments for measuring and recording the growth of plants and their "breathing." The chemical demonstrations include nitrogen fixation by the iron arc, the action of the aluminium rectifier and electrically-regulated thermostat, the electrolysis of liquids and the electro-deposition of metals.

Speaking at the Scientific Novelties Exhibition, Prof. E. Wilson said that the passing of vapours into the air occasioned serious losses. He stated that one firm effected a saving of two thousand tons of copper yearly by passing "vapour" between terminals with a high pressure between them.

Radio Telegraphy in Mines.—Tests conducted at the experimental coal mine of the United States Bureau of Mines at Bruceton, Pa., hold out the hope that radio telegraphy may be used in the future as a means of effective communication between rescuers and miners entombed following fires and explosions. The preliminary experiments in co-operation with the Westinghouse Electric & Manufacturing Co., indicate clearly that signals were heard distinctly through 50 ft. of coal strata, although the audibility fell off rapidly as this distance was increased. The absorption with distance is very great for the short wave lengths used in these tests. Longer wave lengths suffer less absorption and may possibly be found practically effective under certain conditions. With a receiving instrument set at a point 100 ft. underground, signals from KDKA station, East Pittsburg, Pa., about 18 miles from the experimental mine, could be heard distinctly. About 50 ft. from the receiving station was a 6-in. borehole from the surface, lined with iron pipe and containing electric light wires which extended therefrom throughout the mine. The presence of these wires evidently assisted greatly in the reception, for when the receiving set was carried to another point in the mine removed from wires and tracks the signals were barely audible through 50 ft. of cover. A vertical antenna was found to give better results. A horizontal antenna gave practically no reception. A loop of a single turn was used with fair results. All the experiments were tried with a wave length of from 200 to 300 m., except the reception from KDKA, which was 360 m. The strata at the experimental mine lie almost horizontal. The direction of strata may have some influence on transmission, as may also the degree of wetness of the strata. The underground workings of the experimental mine follow a horizontal 5-ft. vein of bituminous coal, and the transmission and reception inside the mine followed the course of this vein.—*Colliery Guardian.*

The "Staff" Director.—In the December *Industrial Welfare*, "R.R.H." points out the need for a special director on the staff of every concern in which, by reason of the numbers comprising the working force, anything like personal contact between the "heads" of the concern and the workers is impossible. The special duty of the "labour" or "staff" director would be to deal with all those questions which are summed up in the word "welfare," which, if treated as they are being treated by a few of the more progressive firms to-day, which have such directors functioning, would more than justify such an appointment.

The Lubrication of I.C. Engines.—Mr. Aubrey B. Smith, the chief engineer of the Vacuum Oil Co., read a paper on this subject before the Chelmsford Engineering Society on December 14th. So much depends on the selection of oils that it was the author's opinion that the only satisfactory course was to inform the lubrication experts exactly what was required of the lubricant and leave them to supply an oil to meet the case. The characteristics of compound and straight mineral oils were discussed at length and various special uses for each mentioned. A figure of 4.5 grammes of lubricating oil per b.h.p.-hour was given as a good average consumption under proper working conditions.

A Cable Trench Plough.—The two accompanying views will be of interest, as they illustrate tackle belonging to Messrs. T. Roddis, Ltd., of Roade, Northants., cutting trenches for the Northampton Electric Light and Power Co., Ltd., using a plough of special design, the invention of Mr. K. W. Willans, joint managing director of the firm. By means of this appliance we are assured that it is possible to

A Cable Trench Plough, and the Trench it Made.

cut trenches in which to lay cables at a considerably reduced cost. Working with a pair of engines and five men, the firm has recently excavated a trench for the above-named company 330 yd. long, 15 in. wide, and 20 in. deep, in three hours, the work starting at 2 p.m. and finishing at 5 p.m. on the same afternoon. The makers of the tackle claim to be able to excavate under good conditions as much as 900 yd. of trench per day.

Fuel Oil.—In the course of a paper on the above subject, which Mr. A. F. Baillie delivered, with the aid of lantern slides, at the Institution of Rubber Industry on November 20th, it is pointed out that in steam-generating plant the practice of burning oil at the same time as the coal materially increases the overall efficiency of combustion, due to the oil flame raising the combustion temperature and thus thoroughly consuming any possible unburnt gases which might pass off when burning coal alone, but the question was not developed until about seven years ago, when power-station engineers started taking a keen interest in the subject. The theory is that a poorer class of coal can be used in conjunction with fuel-oil than can be burned alone satisfactorily under the boilers, due to the fact that poor coal tends to cake on the links of the chain-grate stokers, thereby retarding the necessary quantity of air from being drawn through the bars to complete combustion.

Sufficient interest was taken in this theory for a large London power station authorities to give their sanction for tests to be carried out under one of their coal-fired Stirling water-tube boilers. One burner was introduced into each side of the boiler, approximately 25 per cent. from the back of the grate, the burners being opposite one another. The fuel oil, stored in an overhead tank, gravitated to the burners, which were of the Kermode steam-jet type, operating with steam as an atomising agent, at a pressure of about 25 lb. per sq. in. The coal test was carried out on a nutty slack, having a calorific value of 10,400 B.th.u., and a boiler efficiency of 69.25 per cent. was obtained. The temperature of the combustion chamber was 2,648° F., and that of the uptake 660° F.

The last of a series of experimental mixed-burning tests was carried out on a nutty slack, having a calorific value of 10,300 B.th.u., and Mexican fuel oil having a calorific value of 18,750 B.th.u. A boiler efficiency of 74 per cent. was obtained, and the temperature of the combustion chamber was 2,850° F., and that of the uptake 628° F. The proportion of oil to coal on a B.th.u. basis was 8 per cent. and on a weight basis 4.96 per cent. It will be noted, therefore, that in addition to the previous claim of the pioneers of this system, a large increase in the boiler rating can be quickly attained, and also that the rated evaporation was much more mobile with mixed firing than with coal firing.

Relay Protection for Transmission Systems.—In a paper read recently before the Engineering Institute of Canada, Mr. P. Ackermann described a system of protection for transmission systems which was instituted by him as engineer to the Shawinigan Water & Power Co. In an introduction it was pointed out that the ordinary excess-current system was not adaptable to the special circumstances for several reasons. The main reason was that the generator capacity had an extremely wide variation—from 12,000 to 35,000 kVA—depending upon load conditions. Thus it was possible to encounter a short-circuit current much below any value for which relays could reasonably be set. It appeared necessary to take advantage of the drop in voltage accompanying faults, and development was carried out in this direction.

If the impedance drop of a line was 10 per cent. of normal voltage with normal line current flowing, the line, if short-circuited at one end, would require 10 per cent. of normal voltage at the station bus bars to cause normal current to flow in the line. Any greater short-circuit current under the same condition would leave a proportionately high voltage at the station bus bars. In the case of a line short-circuit nearer the station the impedance would be lower, and as a result less voltage would be left at the bus bars with the same current flowing in the line, compared with a distant short-circuit. A relay consisting of a beam pivoted in the centre, and equipped at either end with a solenoid, with a current coil fed from the line at one end, and a potential coil fed from the bus bars at the other, was adjusted with respect to current and potential coils in such a fashion that when the current coils overpowered the potential coil a trip circuit was closed and the line circuit broken. Relays of this nature were placed at different parts of the line and operated satisfactorily. From the foregoing it will be seen that the system possesses among other advantages, not obtained with the excess-current principle of protection, operation irrespective of the actual magnitude of current and voltage; and the relays are therefore unaffected by load conditions or generator output.

A Rotating-Tube Boiler!—Extended tests of a new type of steam boiler known as the "Atmos" boiler have just been completed at Gothenburg, Sweden, the inventor being Mr. Victor Blomqvist, a mechanical engineer of Stockholm. The basic principle is that the tubes, straight and of unusually large diameter, are kept constantly rotating at 330 r.p.m. about their longitudinal axis. This is said to force the steam bubbles instantly toward the centre of the tube, because of the centrifugal action of the water. The walls of the tubes are thus constantly covered with a layer of water and there is the greatest possible transmission of heat. The tubes are rotated by a steam turbine or electric motor, driving through a gear train.—*Power.*

Electric Vehicles in Ceylon.—The municipal authorities in Colombo are making all efforts to bring the City Corporation up to the standard of progressive English municipalities. A proposal has been made to introduce electrically-driven street watering vans. The idea is to set up the requisite plant so that the municipality can itself charge batteries. There is no proposal to electrify all the municipal haulage plant, as for some purposes steam and petrol are found more suitable. But the general policy is to "motorise" where increased efficiency or reduction in cost can be secured thereby.—*Indian Engineering.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. Reginald S. Wilson resigned his position as Director of Aircraft at the Air Ministry Supplies as from December 31st. He proposes to continue his practice as consulting engineer, but at new offices—Central House, Kingsway, London, W.C.

It is announced in a financial daily that Sir Vincent L. Raven, K.B.E., M.I.C.E., M.I.M.E., late chief mechanical engineer of the North-Eastern Railway Co., has joined the board of Metropolitan-Vickers Electrical Co., Ltd.

Mr. J. E. Stewart, M.Inst.C.E., M.I.E.E., for the last eight years manager and engineer to the Llanelly and District Electric Light and Traction Co., has started business on his own account at Castle Buildings, Llanelly. He will also open an office at Swansea shortly.

We have pleasure in congratulating Mr. Edward Manville, M.P., M.I.E.E., first past-president of the Engineers' Club and prominent in so many different capacities, upon the honour of Knighthood that has been conferred upon him. His name appeared in the New Year Honours list on Monday, his services rendered to the Board of Trade being specially mentioned.

Stepney Borough Council Electricity Committee has appointed Councillor Rosenthal chairman and Councillor Hasted vice-chairman for the ensuing year.

Mr. F. Geere Howard informs us that he has resigned his directorship in Messrs. F. Geere Howard, Ltd.

Mr. Norman Land, of the staff of the Leatherhead Electricity Works, who is leaving for Australia, has been presented with a silver cigarette case.

After being for nearly 30 years engineer and manager of the electricty undertaking in Preston (formerly for the National Electric Supply Co., Ltd., and latterly for the Preston Corporation), Mr. J. H. Tonge is retiring and intends to practise as a consulting electrical engineer in Preston, where he will shortly open an office. For the present he asks that letters should be addressed to "Ash Grove, Nooklands, Preston."

Obituary.—Sir John Gavey.—It is with feelings of very deep regret that we learn of the death, which occurred on Monday last, at "The Croft," Hampton Wick, of Sir John Gavey, for five or six years (1902-7) a much-appreciated engineer-in-chief of the General Post Office and for the year 1905-6 a highly-esteemed president of the Institution of Electrical Engineers. On his election as president we gave an illustrated account of his career (Elec. Rev., November 3rd, 1905), and on his retirement from the chief-ship at the G.P.O. we reported at length the speeches in which his sterling virtues and technical and administrative capabilities were reviewed (Elec. Rev., April 19th, 1907); but nothing that has come to pass in the fifteen intervening years has lessened—rather have events enhanced—the high qualities of character and the importance of his life work. Like many another he was destined to spend his closing years apart from the sterner activities, but those who knew him in the old days and those who remember him comparatively recently, too, will endorse the comment that we made when he took office at the I.E.E. :—"His straightforwardness has gained for him the esteem and affection of all who admire a frank, fearless, and manly nature; and he is as modest as he is able."

Sir John Gavey was born in 1842, and had therefore passed his eightieth year. After his education at Victoria College, Jersey, he, in 1860, joined the Electric and International Telegraph Co., and in 1870, when the service was transferred to the State, he was appointed superintendent of the South-Eastern Division. Two years later he was transferred to the Great Western Division, with headquarters at Bristol under W. H. Preece. Between 1872 and 1892 he was engaged on heavy trunk telegraph line construction work, investigations of and improvements in high-speed Wheatstone working, wireless telegraphy by induction, and telephone line work. In 1892, on the death of Mr. E. Graves (engineer-in-chief), Sir John (then Mr.) Gavey was appointed principal technical officer at headquarters, and in this position he carried out further important experiments in wireless telegraphy by induction, but while his work included much telephone engineering work, practically his largest and his chief undertaking in connection with telephonic intercommunication was the installation of the immense network of underground wires in London. Sir John Gavey served as a juror to the electrical section of the Paris Exhibition of 1900, and in the same year he was a delegate to the International Electrical Congress. He was the official delegate at the preliminary International Congress on Wireless Telegraphy held in Berlin in 1903. He served on many committees connected with international exhibitions, engineering standards, &c., and, in addition to being the author of a number of papers on telegraph and telephone matters read at the I.E.E., he was numbered among those who contributed to the Electrical Review in its very early days. When he retired from the position of Engineer-in-Chief he was appointed Consulting Engineer to the Post Office, and he held that office from 1908-1913. The distinction of C.B. was conferred upon him in 1913, and the honour of knighthood in 1907 on his retirement. Since 1907 he had been a director of the United River Plate Telephone Co., Ltd., and had visited South America in connection with the business of that company. The funeral service takes place to-day at St. John's Church, Hampton Wick, followed by the interment at Teddington Cemetery.

Herr Carl Muller.—The death is announced from Lengerich, Westphalia, of Herr Carl Muller, who had been a director of the Westfalen Electricitatswerke Gesellschaft since 1907.

Mr. J. W. Salisbury.—The death has taken place, at the age of 88 years, of Mr. James Wright Salisbury, of Limbrick Hall, Harpenden Common, Herts., who was chairman of the Basian Meter Co., Ltd.

Will.—The late Sir A. W. Shipley, brewer, and chairman of the Windsor Electrical Installation Co. Ltd., left £79,624.

NEW COMPANIES REGISTERED.

Belling & Lee, Ltd. (186,538).—Private company. Registered December 20th. Capital, £1,000 in £1 shares (10 founders' and 990 ordinary). To acquire and turn to account any patent or invention relating to wireless telegraphy or telephony, &c. The joint managing directors are: C. R. Belling, 10, Glebe Avenue, Enfield, Middlesex, electrical engineer; E. M. Lee, 27, Ridgeway, Enfield, Middlesex, radio engineer. Qualification: £200.

Electric Auto Supplies, Ltd. (186,683).—Private company. Registered December 27th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in electric lamps of all kinds, &c. The subscribers (each with one share) are:—B. B. Fenn, 30, Langham Street, W.1, electrical engineer; Esther Gold, 30, Langham Street, W., bookkeeper. The first directors are: B. B. Fenn, Anne Tj Reitsma, and Willem Anne Van Heyningen. Secretary: Miss Esther Gold. Registered office: 30, Langham Street, Great Portland Street, W.1.

Savoy Electric Construction Co., Ltd. (186,650).—Private company. Registered December 22nd. Capital, £2,000 in £1,300 10 per cent. preference shares of £1 each and 14,000 ordinary shares of 1s. each. To adopt an agreement with C. A. Crosbie and to carry on the business of electrical, mechanical, constructional, and general engineers, &c. The subscribers (each with one ordinary share) are:—E. J. Y. Crosbie, 25, Abchurch Lane, E.C., bank clerk; L. A. Frost, 110, Nimrod Road, Streatham, S.W.16, clerk. The directors are: C. W. Crosbie and Margaret Crosbie. Registered office: Doric House, 1, Museum Street, W.C.

Insulating Materials, Ltd. (186,588).—Private company. Registered December 21st. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of all kinds of electrical and heat-insulating materials, electrical appliances, and apparatus, &c. The first directors are: F. J. Heijes (manager), 123, Davyhulme Road, Stretford, Manchester; F. J. Knight, "Rosslyn," Perry Street, Wendover, Bucks. Qualification: £25. Registered office: 14, Appleton Village, Widnes.

Dorco Engineering Co., Ltd. (186,662).—Private company. Registered December 23rd. Capital, £100 in £1 shares. To carry on the business of electricians, manufacturers of generators, accumulators, suppliers, and distributors of electricity and electrical energy. The subscribers (each with one share) are: K. E. M. Kemp, 165, Pembroke Road, Seven Kings, Essex, solicitor's clerk; W. Dawson, 50, St. George's Road, Golders Green, electrical engineer. The subscribers are to appoint the first directors. Qualification: One share. Remuneration (except managing director or manager), £25 each per annum. Registered office: 86, Granville Road, Child's Hill, Cricklewood, N.W.

Radio Gramophones, Ltd. (186,562).—Private company. Registered December 20th. Capital, £2,000 in £1 shares. To carry on business as indicated by the title and that of electrical engineers and contractors, suppliers of electricity, &c. The first directors are: J. S. Cotman, "The Old House," Pyrford, Surrey; N. Holbrook, "Stoke Lodge," Hyde Park Gate, S.W.1; G. P. Botterill, 1, Knaresborough Place, Kensington, S.W.; A. H. Philpot, "Studley," Grosvenor Road, N.10; L. W. Millar, 16, Edith Road, Selhurst, Croydon. Secretary: H. G. Boak. Registered office: 10, Coleman Street, E.C.

J. W. Barnard & Haynes, Ltd. (186,637).—Private company. Registered December 22nd. Capital, £3,000 in £1 shares. To take over the business of a mechanical and electrical engineer carried on by J. W. Barnard at 45, Great Ormond Street, 55, Ormond Yard, W.C., and 4, Great Winchester Street, E.C. The first directors are: J. W. Barnard, "Glencoe," Laleham Road, Shepperton-on-Thames (permanent chairman and managing director); H. E. Haynes, 23, Musgrove Road, New Cross, S.E.; F. G. Tolley, 18, Jasmine Grove, Anerley, S.E.; C. H. Tolley, 107, Tierney Road, Streatham Hill, S.W.2. Remuneration as fixed by the company. Registered office: 4, Great Winchester Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

K. H. E. Ignition Co., Ltd.—Particulars filed of £500 debentures authorised December 12th, 1922, charged on the company's undertaking and property, including uncalled capital, the amount of the present issue being £250.

Western Electric Distributing Corporation, Ltd. (79,057).—Return dated November 1st, 1922. Capital at date of return, £50,000 in 17,000 cum. pref., 3,000 pref., and 30,000 ord. shares of £1 each (increased November 24th, 1922, to £100,000 in 50,000 cum. pref., 3,000 pref., and 47,000 ord. shares of £1 each). 14,245 pref., 2,875 pref. ord., and 29,778 ord. shares taken up. £46,423 paid, leaving £475 in arrears. Mortgages and charges: nil.

Tramway Supplies, Ltd. (93,698).—Return dated October 25th, 1922. Capital, £10,000 in £1 shares. 5,307 shares taken up. £2,307 paid. £3,000 considered as paid. Mortgages and charges, £5,589 7s. 6d.

Walsall Electrical Co., Ltd. (37,696).—Return dated November 16th, 1922. Capital, £30,620 in £1 shares. 12,000 shares taken up. £10,000 paid. £2,000 considered as paid. Mortgages and charges: nil.

W. H. Dorman & Co., Ltd.—Particulars filed of £150,000 debentures authorised November 24th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior charges, the amount of the present issue being £80,000.

Telephos, Ltd.—Particulars filed of £3,000 debenture authorised March 30th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued (filed December 14th).

Electric House Cafes, Ltd.—Debenture dated December 7th, 1922, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Branch Nominees, Ltd., 15, Bishopsgate Street, E.C.

CITY NOTES.

Durelco, Ltd.

A report of the second annual meeting of this company, appearing in the *Financial Times*, states that it was held on December 29th in London, Mr. W. L. T. Arkwright presiding. He said that, in common with others, their business had suffered from the practically universal depression in industry. The electric lamp trade was among the first to suffer from the slump, and the consumption of lamps in the United Kingdom during the past year was very considerably below the normal, owing very largely to the fact that so many factories were either closed or working on short time, and to depressed trade generally. In addition to this, the company's trade in tungsten wire suffered severely owing to the fluctuating rates of exchange abroad, some 80 per cent. of their trade in tungsten wire being in foreign markets. During the last few months, however, their businesses had shown a marked improvement, and as considerable economies in the cost of manufacture and general administration had been effected, there was every reason to believe that the present year would show considerably better results. This company did not itself trade, its business being to finance and control certain businesses connected with the electric lamp trade. For many years past litigation had been proceeding between one of their companies (Duram, Ltd.) and the British Thomson-Houston Co., Ltd., which, besides being a drain on the resources of the company, to some extent restricted the company's normal expansion by limiting their markets to firms outside the Association. As the result of protracted negotiations by the board in November last, the litigation in question was settled between the parties by their two subsidiary companies, Cryselco, Ltd., and Duram, Ltd., taking licences from the British Thomson-Houston Co., Ltd., and associated companies on mutually satisfactory terms, and the directors now looked forward to a new era of prosperity unfettered by expensive and vexatious litigation. The settlement of the dispute also had a direct influence upon their lamp business, which was now able to operate under the patents which controlled the industry, and they confidently believed that they would shortly place on the market a thoroughly satisfactory half-watt lamp. On this class of lamp there was a distinctly larger margin of profit than on the vacuum lamps which they had hitherto alone been making.

German Companies.

The *Bergmann Electricity Undertakings Co.*, of Berlin, reports net profits of 200,000 marks for 1921-22, or the same amount as in the preceding year. No dividend is proposed, as was also the case for 1920-21.

The *Rhenish Electricity Co.*, of Mannheim, which is both a contracting and investment concern, records net profits of 11,370,000 marks for 1921-22, as compared with 4,313,000 marks in the previous year. The rate of distribution is increased from 15 per cent. in 1920-21 to 25 per cent. last year.

The *Electric Light & Power Investments Co.*, of Berlin, reports that all the undertakings are in course of promising development, although the supply works suffer from the scarcity of coal and the tramways from the high fares. The net profits in 1921-22 are reported at 29,900,000 marks, as compared with 3,600,000 marks in the previous year, and the dividend rises from 10 per cent. in 1920-21 to 25 per cent. last year.

French Electrical Company.

The report of the *Compagnie Générale d'Electricité* for 1921-22 states that the indications of a resumption of economic activity were strengthened during the year. The resumption was manifested in the final months by a noteworthy increase in the orders and in the number of customers of electric supply companies. However, the financial results for the year would have been mediocre if the directors had not drawn upon the exceptional profits derived from the transfer of the incandescent lamp department. After mentioning the absorption of the Tudor Accumulator Co., the report passes in review the situation of the various undertakings in which the company is interested. Including the balance brought forward, the accounts show net profits of 10,240,000 fr., permitting of the payment of a dividend at the rate of 60 fr. per share, less tax. It was mentioned at the recent annual meeting that the inflow of orders at present holds out the prospect of the new financial year being as favourable as 1921-22.

Claud Hamilton, Ltd.

At the annual meeting in Glasgow, on December 27th, Mr. Alex. J. Fergusson, chairman, stated that in common with the experience of other similar companies, the depression in trade and the fall in prices had adversely affected the profits for the year. The company had been expending considerable sums on capital account in connection with its branches, which had to be provided partly out of profits. Under these circumstances the directors considered it necessary to conserve the resources of the company, and although the amount at the credit of profit and loss was £19,524, they only recommended the payment of a dividend of 5 per cent., less tax, on the ordinary shares, carrying forward the balance, subject to excess profits duty and corporation tax.

Mexican Electric Power Companies.

The *Financier* states that the bondholders of the Guanajuato Power and Electric Co., the Michoacan Power Co., and Central Mexico Light and Power Co. have been advised that fortunately, with increased business and postponement of constructional work, the cash resources of the companies have accumulated to such an amount as to justify the payment, on January 1st, 1923, of all interest accruing up to and including that date on their bonded indebtedness, and still leave a balance sufficient to meet all emergencies likely to occur. The bondholders are also advised that there has been no marked change in general political and business conditions in Mexico since the date of the last report. The business of the companies has continued to increase to such an extent that it will probably be necessary to increase the generating capacity in the near future, or increase the supply of power otherwise, in order to avoid being obliged to refuse desirable new business that will be offered. This, however, would involve a large expenditure for construction work, and it is not thought wise to make this expenditure until political and labour conditions are more stable than at present, but the companies' engineers are making a thorough examination of the most feasible plans for enlarging capacity, and all the necessary preparations for proceeding promptly when the proper time comes, are being made.

Bullers, Ltd.

The report for the two years ended July 31st, 1922, states that only provisional settlement has been reached in the matter of excess profits duty. For 1921 extremely heavy depreciation on plant and buildings was written off, and a loss of £5,595 resulted. The directors have acted on the most conservative principles throughout. The balance brought forward from the preceding year was £8,948, from which the preference dividend (£7,500) has to be deducted. The directors propose to transfer £45,000 from the general reserve, which after writing off the debenture issue expenses, £24,252, will leave £20,748. After transferring to sinking fund for redemption of debentures £4,650 and debiting the loss of £5,595, there remains to carry forward £11,951. After making provision for depreciation of stocks, debenture interest, directors' fees and salaries, the accounts for the year ended July 31st, 1922, show a profit of £8,471, plus £11,951 brought forward, making £20,422. After deducting the preference dividend and transferring £4,900 to sinking fund for redemption of debentures, £8,022 remains, and the directors propose to carry it forward.

Ferranti, Ltd.—By an Order of the High Court, Chancery Division, separate meetings of the preference, the ordinary, and the deferred shareholders will be held at Winchester House, Old Broad Street, E.C., on January 12th, for the purpose of considering and, if thought fit, approving the proposed scheme of arrangement sanctioned at the meeting held on December 14th (*vide* ELECTRICAL REVIEW, December 15th and 22nd).

Agricultural and General Engineers, Ltd.—The directors have decided to defer the consideration of the payment of dividends on the first and second cumulative preference shares until the accounts for the financial year ending March 31st next are completed and the result of the year's trading is definitely ascertained.

Victoria Falls and Transvaal Power Co.—According to the *Financial Times* the net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended September 30th, 1922, amounted to £239,082 before providing for British and South African taxation.

STOCKS AND SHARES.

TUESDAY EVENING.

SETS of statistics must always be introduced, in the opinion of a Stock Exchange and a diffident writer, with apologetic references to the difficulty of making them interesting. Their justification can be the more easily defended, perhaps, in summing-up the net results of a year like that just ended, because in the examples with which we deal, every case but two shows a rise on the year. The pair of exceptions—

General Electrics and India Rubbers—wound up 1922 at the same prices as those which ruled twelve months earlier.

The gains in the Electricity Supply market are rather astonishing. Relatively, the proportions are little short of remarkable. What makes them still more noteworthy is the fact, demonstrated by the following table, that every price at the end of 1921 stood higher than that of December, 1920.

Five years' comparison is set out in these tables. The final column shows the improvement which occurred during 1922. As mentioned here on several previous occasions, the reason for the rises is that the supply companies are expected to present exceedingly good reports, with increased dividends without exception, so far as the London undertakings are concerned. It deserves to be recalled that the County of London Co. made a new issue of ordinary and 6 per cent. preference shares last May, at 22s. 6d. and 20s. respectively, the present prices of the shares being 7s. 3d. and 1s. 10½d. premium. Here is the first set of tables :—

ELECTRICITY SUPPLY SHARES.

Ordinary.	1918.	1919.	1920.	1921.	1922.	Rise, 1922.
Brompton	7½	5⅞	6	6⅜	10½	3⅜
Charing Cross	3⅜	2⅜	3⅜	4⅜	7⅜	3⅜
Chelsea	4	3	3⅜	3¼	6⅜	3⅛
City of London	13	12	14	1⅞	2⅛	⅛
County	11⅜	9⅛	7⅜	8¼	1⅞	6⅜
Kensington	5⅜	4⅜	5⅜	5⅜	8	2⅝
London	1⅜	1⅜	⅞	1	2⅛	1⅛
Metropolitan	2	3	2⅜	3⅜	6¼	2⅞
St. James'	7⅜	6	6¼	6⅜	9¼	2⅞
South London	3	2½	2⅜	2⅜	4⅜	1⅝
Westminster	7½	5⅜	4½	5⅜	7⅜	2

Amongst the stocks and shares of the cable companies the gains are substantial; even West India and Panama ordinary shares have doubled in price. The progress made in wireless and broadcasting developments has had no effect in checking the support accorded by investors to the older cable descriptions. Eastern Ordinary is 30 points to the good, the rises in Eastern Extension, Globe and Western shares being almost as great. Marconi's have put on 11s. 3d., and the company has successfully floated a debenture issue, the price being now 3¼ premium. Anglo-Americans have also improved, and the telephone shares have gone ahead with the rest. We give the five years' comparison in all our tables :—

TELEGRAPHS, &C.

Stock or share.	1918.	1919.	1920.	1921.	1922.	Rise, 1922.
Anglo-American Pref. ...	99	90½	75½	84½	103	18⅜
Eastern Extension	15⅜	16⅜	14⅜	16½	19⅜	2⅞
Eastern Telegraph	157½	168½	152½	166⅜	190⅜	30
Globe Ord.	14⅜	16⅜	14⅜	16½	19⅜	2⅜
Great Northern...	33	23½	20⅝	26½	29½	2⅞
Indo-European...	59½	48½	30	27⅜	35½	8
Marconi	4⅞	4⅜	2⅛	1⅜	2⅝	⅜
United River Plate	7⅜	7⅜	5⅜	5⅜	7½	1⅜
West India and Panama ...	1½	1⅜	⅞	⅞	1⅜	½
Western Telegraph	16½	17½	14⅜	16½	19	2½

The year in which the grouping arrangements came into force in the Home Railway world resulted in big rises amongst the stocks, in which rises the Undergrounds participated. Owing in some measure to the pressure of the unemployment problem, extensive new electrification programmes have been taken in hand. With a Government guarantee three of the Tube Railways were able to raise money on easy terms. Early new issues this year will include invitations to subscribe capital for similar purposes by other railway companies. Prices of Metropolitan and District ordinary stocks have more than doubled within the twelvemonth. The strength of Metropolitan is due in part to the renewed hope of the railway's being absorbed by the Great Western :—

RAILWAY STOCKS AND SHARES.

Stock or share.	1918.	1919.	1920.	1921.	1922.	Rise, 1922.
Central London Ord.	65½	58½	49½	51½	67	15½
Metropolitan	31½	25½	20	26½	60	33½
District	26	21	15½	21½	47	25½
Underground Ord.	3⅜	2½	1⅜	2	2⅞	⅝
,, A	8/9	6/6	5/-	6/-	7/-	1/-
,, Inc.	92½	81	60½	75½	87½	12

Manufacturing companies' shares make a somewhat mixed showing. The cable concerns have done very well. Some of the electrical manufacturers have had a poor time. In the engineering group Babcock & Wilcox have come up sharply :—

MANUFACTURING.

Share.	1918.	1919.	1920.	1921.	1922.	Rise, 1922.
Babcock	3⅛	3⅞	2⅛	2⅜	3½	1⅛
British Aluminium	1⅜	1⅜	17/6	15/-	16/-	1/-
British Westinghouse Pref. ...	2½	2½	1½	1⅜	2⅛	⅛
Callender's	10½	8⅛	1⅛	1⅜	2⅛	⅛
General Electric	17⅞	2	19/6	18/3	18/3	—
Henleys	2⅛	2⅛	1⅛	29/6	46/9	17/3
India Rubber	17	18⅛	⅛	⅛	⅛	—
Telegraph Construction ...	48	26⅜	20½	21½	25⅞	4½

Armaments have risen materially since a year ago. Foreign traction issues went up, in some cases, by leaps and bounds, British Columbia Electrics being especially favoured in this respect.

The past year proved a good one for investors in practically every market. The Stock Exchange has got back to pre-war conditions of business in the matter of fortnightly settlements, and all that these involve, and with the new year the ELECTRICAL REVIEW catalogue of prices is once more increased to a length more commensurate with the importance of the markets with which these columns make a modest attempt to deal.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend. 1920.	Dividend. 1921.	Price Jan. 2, 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	7½xd	—	£5 14 3
Charing Cross Ordinary	8	9	7⅞	—	5 16 2
do. do. do. 4½ Pref.... ...	4½	4½	4⅞	—	5 7 5
Chelsea	6	6	6⅞	—	4 9 0
City of London	14	14	2⅞	—	6 7 10
do. do. 6 per cent. Pref. ...	6	6	23/-	—	5 4 4
County of London	8	8	32/-	+9d.	5 0 0
do. do. 6 per cent. Pref. ...	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	Nil	Nil	1½	—	Nil
do 6 per cent. Pref. ...	6/-	12/-	4⅜	—	6 17 2
Kensington Ordinary	9	10	8	—	6 5 0
London Electric	2½	4	8	+ ⅛	4 0 0
do. do. 6 per cent. Pref. ...	6	6	5⅛	—	5 17 1
Metropolitan	7	7	6½	—	5 7 8
do. 4½ per cent. Pref. ...	4½	4½	4⅛	—	5 9 1
Newcastle-on-Tyne Ordinary	8	Nil	⅛	+ ⅛	Nil
do 5 per cent. Pref. ...	5	5	14/6	—	6 18 0
do 7 per cent. Pref. ...	—	7	22/-	—	6 7 3
Notting Hill, 6 per cent. Pref.	6	6	9	—	6 13 4
North Met. Elec., 6 per cent. Pref. ...	6	6	1⅛	—	5 13 0
Urban Ordinary	Nil	Nil	1⅛	—	Nil
do 5 per cent. Pref. ...	2½	2½	3⅞	—	6 13 4
St. James' and Pall Mall	12	12	9½	—	6 6 4
South London	7	7	4⅜	—	5 18 0
South Metropolitan Pref.	7	7	1⅛	—	5 18 0
Westminster Ordinary	10	10	7⅞	—	6 7 0
Whitehall Elec. Inst., 7½ per cent. Pf.	—	7½	17/6	—	8 11 6

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	103	+ ½	5 16 6
do. Def.	1½	34/6	24½	+ ½	6 4 4
Chile Telephone	6	6	6½	—	4 16 0
Cuba Sub. Ord.	7	7	7⅞	— ⅛	9 0 8
Eastern Extension	10	10	19⅛	—	5 4 0
Eastern Tel. Ord.	10	10	190½	—	5 5 0
Globe Tel. and T. Ord.	10	10	19⅛	—	5 5 0
do. do. Pref.	6	6	11⅛	+ ⅛	5 6 8
Great Northern Tel.	24	22	29xd	+ ½	7 11 8
Indo-European	10	10	35½	—	7 1 0
Marconi...	25	15	2⅞	+ ⅛	6 9 10
Oriental Telephone Ord.	12	12	2⅞	—	*5 4 0
United R. Plate Tel.	8	8	7⅜	—	*5 6 8
West India and Panama	Nil	Nil	10/-	—	Nil
Western Telegraph	10	10	18⅝	— ⅛	*5 6 8

HOME RAILS.

Central London Ord. Assented	4	4	67	—	5 19 5
Metropolitan	1½	2½	61	+1½	3 13 8
do. District	Nil	1	47	+2	2 2 6
Underground Electric Ordinary... ...	Nil	Nil	2⅜	—	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	2	4	87½	—	*4 11 5

HOME AND FOREIGN TRAMS, &C.

Anglo-Arg. Trams. First Pref.	5½	12½	38	— ⅛	7 11 9
do. do. 2nd Pref.	Nil	5½	4½	— ⅛	6 2 3
do. do. 5 per cent. Deb. ...	5	5	80½	—	6 2 8
British Electric Traction Ordinary ...	4½	—	64	—	7 0 8
do 6 per cent. Pref. ...	6	6	94	+1	6 7 8
Brazil Tractions	Nil	Nil	47½	— ½	8 8 6
British Columbia Elec. Rly. Pce. ...	5	5	78½	—	6 7 5
do. do. Preferred ...	5	98/-	70½	—	*6 3 6
do. do. Deferred ...	8	124/-	87½	—	*7 0 6
do. do. Deb.	4½	4½	78½	—	5 8 3
Lond. and Sub. Trac., 5 per cent. Pf....	2½	3½	10/-	—	7 0 0
London United Tram deb.	4	4	64	—	6 5 0
Mexico Tram. 5 per cent. Bonds ...	Nil	Nil	81½	—	6 2 8
do. 6 per cent. Bonds ...	Nil	Nil	89½	+1	Nil
Mexican Light Common...	Nil	Nil	21½	—	Nil
do. Pref.	Nil	Nil	51½	—	Nil
do. 1st Bonds.	Nil	5	67	—	7 8 2

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	16	3½	+ ⅛	4 11 6
British Aluminium Ord.	10	5	16/-	—	6 3 6
British Insulated Ord.	15	15	2⅛	—	6 13 4
Callenders	15	15	2⅛	—	6 17 0
do. 6½ Pref....	6½	6½	1⅜	—	5 15 7
Crompton Ord.	10	5	18/-	—	6 13 4
Edison-Swan	10	Nil	2/6	—	Nil.
do. do. 5 per cent. Deb.	5	5	63	—1	7 18 9
Electric Construction	10	10	1⅜	—	7 5 6
English Electric	8	5	15/0	—	6 7 0
do. do. Pref.	6	6	18/3	—	6 10 6
Gen. Elec. Pref.	6½	6½	21/9	—	5 19 6
do. Ord.	10	5	18/6	+6d.	5 8 1
Henley	15	15	2⅛	—	6 11 3
do. 4½ Pref.	4½	4½	4⅜	—	5 2 10
India-Rubber	10	—	11/3	—	—
Met.-Vickers Pref.	8	8	2⅛	—	6 11 2
Siemens Ord.	10	10	1⅛	—	—
Telegraph Con.	20	20	25½	—	*4 11 5

* Dividends paid free of Income Tax.

ESTIMATING OFFICE ORGANISATION.—V.

By MAJOR J. C. CONNAN, B.Sc., A.M.I.E.E.

DATA SHEETS.

THE data sheet below is designed for an electric lighting installation, and consists of a single foolscap sheet, the front page of which is provided for supplying general information, and the back page for technical data. The notes are intended to amplify the questions, and indicate what type of information is necessary. To save space and time, the suggested abbreviations may be used. The data sheet represents the minimum information necessary to make a satisfactory estimate, and more information, given in the "remarks" paragraph or in a separate letter, will always increase its value.

When the estimate is completed, the data sheet should have the estimate number added in the space provided, and should be filed away with the draft estimate. It provides full information, ready to hand, of the basis on which the estimate was calculated, and greatly facilitates getting out alternative offers when these are called for.

LIGHTING INSTALLATION.

TECHNICAL DATA.	ESTIMATE NO.				
1. No. of Floor					
2. Dimensions of Area to be Lighted :—					
Area, sq. ft.					
Length, ft.					
Breadth, ft.					
Ceiling height, ft. ...					
3. Particulars of Bays in Area :—					
Length, ft.					
Breadth, ft.					
Girder depth, ft. ...					
4. Ceiling Design					
5. Colour or % Reflecting Power of					
Ceiling					
Walls					
Floor					
Fittings					
6. Work carried on in the Area ...					
7. Surroundings of Area					
8. System of Illumination desired..					
9. Type of Illuminant desired ...					
10. Type of Fitting desired ...					
11. System of Wiring desired ...					
12. Arrangement of Switching desired					
13. Is Emergency Lighting necessary?					
14. Intensity of Illumination chosen					
15. Utilisation Efficiency chosen ...					
16. Mounting Height chosen in ft....					
17. Size of Lamp chosen					
18. Class of Building. Type.....					
Condition.....					
19. Electricity Supply :—(*a*) Private or Public.....					
(*b*) System.....					
(*c*) Voltage.....					
(*d*) Are there any Special Regulations?...					
20. Normal Working Hours. From.....To.....					
21. The Installation will be Insured with.....					
22. Remarks :—					

GENERAL DATA AND NOTES.

Date.

1.—Name of firm .....
2.—Address of firm .....
3.—Address of factory.....
4.—Name of consulting engineer.....
5.—Address of consulting engineer .....
6.—To whom has the quotation to be sent?.....
7.—By what date? .....
8.—Is there any penalty attached to the contract?.....
9.—Particulars of any plans enclosed .....

NOTES.—GENERAL.

3.—To be given when the installation is not at the address given under 2.

4.—Or architect as case may be.

6.—Engineer, architect, or to firm direct.

8.—If any, give particulars.

9.—Plan and elevation showing roof section should be sent. Min. scale 1 : 100. Drawing Nos. should be given. On plan should be indicated point of supply, point of earth, particulars of existing lights, &c.

TECHNICAL DATA.

4.—Flat (F), flat with projecting girders (G), arched (A), saw-toothed (Z), trussed (V), rough (R), or smooth surface (S).

Construction of ceiling: Ferro-concrete (C), lath and plaster (L), tiles (T), wooden (P), with windows (W), give no. and size of windows.

5.—It is preferable to state colour of walls, &c., and general condition, *i.e.*, clean (C) or dirty (D). The colour of the floor includes the colour of the carpet when used. Colour of fittings, covers, furniture in private houses, offices, &c., or material to be shown in shop windows, or machinery in shops.

6.—Should be as detailed as possible. If the walls are to be well lit in the case of offices, libraries, &c., add (V). Amplify in remarks when necessary.

7.—If there is smoke, dust, or steam in the shop, add (F), (D), (S), and indicate how much by adding much (M) or little (L). If there is an overhead crane, add (O), overhead transmission (T).

8.—Direct (D), indirect (I), semi-direct (S I).

9.—Gasfilled (G), vacuum (V), mercury vapour (M), quartz (Q), neon (N), Moore tube (T), arc lamp flame open (F), ditto enclosed (E).

10.—Pendant (P), ceiling (C), bracket (B), cargo or protected (R), soffitte (S), watertight (W), gastight (G). In the case of special fittings, give P.L. No. and maker.

11.—Conduit light gauge close joint (C J), ditto welded (C W), ditto brazed (C B), ditto solid drawn (C D); add (H) to the above if required heavy gauge, and (G) if galvanised. Casing and capping (C C), lead covered (L C), cab tire (C T); in last two cases add (T) if no surface (O), below surface (U).

12.—All switches on dis.-board (D) or at machines (M). State other requirements in remarks.

14-17.—Unless a technical expert is available to supply these data, the spaces should be left blank for estimator to fill in.

17.—If there is an existing installation and lamps are kept in stock, give sizes stocked.

18.—Wooden, brick, ferro-concrete, stone, steel framework and brick, &c. Old, new, or in process of construction.

A Thief Shocker.—In the *Commercial Motor*, "G. M." describes a means which he has adopted of foiling the car thief and at the same time administering a slight correction. A length of insulated wire is connected to a distributor terminal and carried through a switch to the lowest point of the chassis and a brass chain is attached to the end, making an earth connection. This charges the surrounding ground at a high potential, which is prevented from sending a current to the chassis by the insulation afforded by the tires. So soon, however, as anyone touches any part in metallic contact with the chassis he completes the circuit, receiving an appreciable shock. It is said that the device does not affect the ignition, but it might affect a thoughtless owner!

Labour-saving Bungalows.—On December 23rd, the *Daily Mail* published the winning designs for labour-saving bungalows, which are the outcome of that journal's £500 competition for architects together with the report of the assessors (Mr. E. Guy Dawber and Prof. A. E. Richardson) who congratulate the competitors on the general high standard of their work and their appreciation of the need for the elimination of unnecessary labour in the home to attain which desirable end the aid of electricity has naturally been invoked. The competition was organised in connection with the *Daily Mail* Ideal Home Exhibition in March, 1922, and the number of entrants (768) was more than double the previous best.

NEW ZEALAND TRADE.

(With Electrical Import Statistics.)

In the report of H.M. Trade Commissioner in New Zealand (Mr. R. W. Dalton), which has recently been issued by the Department of Overseas Trade, it is pointed out that the Dominion has been fortunate in escaping fairly lightly from the effects of the international depression which resulted from the war. Mr. Dalton says that almost before the depression hit the Dominion the prices of her produce began to rise, and they have shown a steady tendency to advance ever since. She drew great advantage from the circumstance that her wool losses were much more than counterbalanced by her increased output of dairy produce.

The large stocks of imported goods have been very largely liquidated, with heavy losses, it is true, but without any important disaster, and reports from all over the Dominion show that new buying has already reached quite important dimensions, and tends to increase.

In reviewing the trend of import trade the report differentiates between "competitive" and "non-competitive" imports. All goods which are or could be manufactured in the United Kingdom have been included under the former heading, while those which, for natural reasons, the United Kingdom could not supply, are included under the latter.

In view of the disturbance of British trade with New Zealand caused by the war and the increased trade secured in consequence by other supplying countries, the figures showing the percentage each country took of the competitive trade from 1914 onwards are of special interest:—

Country.	Percentage of Competitive Trade.							
	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
United Kingdom..	67·1	66·2	63·4	53·3	45·8	45·0	56·1	61·0
Australia ...	4·6	6·3	5·8	9·0	14·0	10·5	11·7	9·4
Canada	2·6	3·8	3·6	4·7	5·0	6·4	4·7	4·8
United States ...	11·2	13·2	16·9	21·3	21·8	27·2	17·9	16·4
Japan	1·0	1·9	2·7	4·0	6·2	5·0	2·6	1·2
Other countries ...	13·5	8·6	7·6	7·7	7·2	5·9	7·0	7·2
Total ...	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

As the Trade Commissioner remarks, there can be no doubt that this improvement in the United Kingdom's share is, to some extent, due to the new tariff which came into force on November 4th, 1921. The full effect of the increased preferences given in that tariff will, however, be seen in the figures relating to succeeding years.

With regard to the tariff treatment of electrical machinery and materials, a considerable alteration has been made. Electrical materials, with the exception of meters, lamps, and such articles as cooking and heating appliances, bells, &c., are now all to be included under one heading, and are all to be free under the British tariff, with a duty of 10 per cent. under the foreign tariff. The effect of this arrangement will be to remove the duty formerly charged on British goods of this class and to provide a preference which did not previously exist on insulated cable and wire, carbons, insulating material and insulating tape. The preference on electric cooking and heating appliances and similar small goods has been increased. In the case of lamps the whole system of levying duty has been changed, and the effect of the new arrangement will be to give British lamps a real preference; in the previous tariff an *ad valorem* preference was given, but owing to the lower price of foreign lamps British lamps actually paid a higher duty than their competitors; the duty is now levied according to the wattage of the lamps at so much per bulb.

Rails and other material for railways continue to have a preference of 20 per cent. A new preference is given in the case of copper and other metals in bars, plates, and sheets, and in brass or metal tubing in the rough; the preference on other brass and copper tubing has been increased. On iron and steel pipes and tubes the duties remain much as they were except that the preference in cast-iron pipes over 9 in. in diameter and wrought-iron pipes over 6 in. in diameter has been increased and a new heading has been inserted to make cast-iron pipe, having a thickness of metal not exceeding 5/16ths of an inch, dutiable at the rate of 20 per cent. under the British tariff and 35 per cent. under the foreign tariff whatever the diameter of the pipe. Otherwise cast-iron pipes and wrought-iron pipes under the respective diameters mentioned above remain free of duty under the British tariff, and dutiable at the rate of 20 per cent. under the foreign tariff. An important alteration has also been made in the duties on gas and oil engines; these engines which formerly paid 10 per cent. from all sources are now to be dutiable under the British tariff at the rate of 15 per cent. if they do not exceed 100 b.h.p., and under the foreign tariff at the rate of 25 per cent.; if they do not exceed 100 b.h.p. they will be free under the British tariff and dutiable at the rate of 10 per cent. under the foreign tariff; a further qualification, however, provides that such engines declared for use on motor vehicles, tractors and traction engines will continue to pay 10 per cent. under the British tariff, the new duty under the foreign tariff being 25 per cent. The object of this somewhat involved treatment of these engines is to protect the local industry for low-powered oil engines, while simplifying the working of the tariff with regard to motor vehicles by making motor engines dutiable at the same rate as the vehicles themselves. The duty on steam engines has also been altered to permit the free entry under the British tariff of stationary engines over 200 b.h.p. and to reduce the duty on other types.

Mr. Dalton does not disguise his wish to impress on British firms the fact that, as a whole, the tariff is a practical expression of the desire of the Government of New Zealand to assist British trade with this Dominion to the fullest extent possible. The Government has gone to very great lengths in this direction, and in doing so it has had in a truly extraordinary degree the approval, not only of the House of Parliament as a whole, but of the Press and the general public. The facilities which were given to His Majesty's Trade Commissioner's office to express views on the subject of the effect of the tariff on British trade, not to mention the sympathetic consideration which was given to those views, both by the permanent head of the department and by the responsible Minister, indicate clearly the desire of all concerned to promote the principle of the development of inter-Imperial trade.

By the courtesy of the New Zealand Government, His Majesty's Trade Commissioner was permitted to be present at the meetings of the Commission and to bring to the notice of the Commission such views regarding British trade in the various classes of goods covered by tariff items as it might be desirable to express in British interests. It is impossible to exaggerate the value of the opportunity so given, or to appreciate too highly the courtesy of the Government of New Zealand in giving it.

Thus the new tariff is by no means a fortuitous arrangement of duties. The principle underlying the revision has been to secure revenue, to protect New Zealand industries where such protection seemed justified, and beyond that, deliberately and after careful inquiry to devise means for safeguarding British trading interests with New Zealand by increasing preferences where such increases were most needed and were most likely to assist the purpose for which they were designed without penalising New Zealand interests. The fact that over 85 per cent. of the competitive trade of New Zealand is now covered by preferences and that increases of preference have been been provided in respect of 75 per cent. of the total competitive trade, is sufficient evidence that the Government's intentions have been admirably carried out. Further, by amending the legislation, additional opportunity has been acquired for protecting British interests from dumping and other detrimental measures which, in the past, have frequently proved serious obstacles to British trade.

It will be universally agreed that it should now be the aim of British manufacturers to take advantage of the opportunities offered by these preferences by instituting more active trading campaigns in New Zealand than they have ever started before. Not only, says Mr. Dalton, will such a course improve their own position in the Dominion, but it will serve to impress the New Zealand Government and the people generally that the confidence in British trading ability which has resulted in these increased preferences has not been misplaced.

The report contains a section describing the Government's hydro-electric programme. Later details of the various schemes were, however, given in a statement by Mr. Dalton which was published in our issue of November 29th.

THE ELECTRICAL IMPORTS OF NEW ZEALAND.

The following table shows the values, and in certain instances the quantities, of electrical and allied goods imported into New Zealand in 1921, according to the recently-issued official trade returns. The figures for 1920 have been given for purposes of comparison, and notes of increases or decreases added:—

	1920.	1921.	Inc: or dec.
Electric batteries and cells.—			
Total	£ 44,000	61,000	+ 17,000
From United Kingdom ...	15,000	31,000	+ 16,000
„ United States	29,000	28,000	− 1,000

	1920.	1921.	Inc. or dec.
Generators, motors and transformers.—			
Total	£241,000	401,000	+160,000
From United Kingdom ...	103,000	204,000	+101,000
,, United States	134,000	188,000	+ 54,000
,, Sweden	—	4,000	+ 4,000
Insulated cable and wire.—			
Total	£289,000	460,000	+171,000
From United Kingdom ...	237,000	304,000	+ 67,000
,, United States	23,000	29,000	+ 6,000
,, Japan	6,000	1,000	– 5,000
,, Australia	—	21,000	+ 21,000
Electric lamps.—			
Total	£ 97,000	100,000	+ 3,000
From United Kingdom ...	34,000	37,000	+ 3,000
,, Netherlands	24,000	22,000	+ 2,000
,, Japan	1,000	1,000	—
,, United States	37,000	36,000	– 1,000
Carbons in blocks.—			
Total	£ 13,000	36,000	+ 23,000
From United Kingdom ...	6,000	21,000	+ 15,000
,, United States	6,000	8,000	+ 2,000
Other electrical material.—			
Total	£250,000	413,000	+163,000
From United Kingdom ...	112,000	169,000	+ 57,000
,, United States	114,000	175,000	+ 61,000
,, Japan	11,000	17,000	+ 6,000
,, Australia	—	10,000	+ 10,000
Electricity meters.—			
Total	No. 10,500	22,000	+ 11,500
	£ 32,000	59,000	+ 27,000
From United Kingdom ...	No. 5,280	11,000	+ 5,720
	£ 20,000	36,000	+ 16,000
,, Switzerland	No. 940	700	– 240
	£ 2,400	2,000	– 400
,, United States	No. 5,000	10,000	– 5,000
	£ 9,400	20,000	+ 10,600

	1920.	1921.	Inc. or dec.
Recording and testing instruments and meters.—			
Total	£ 12,000	16,000	+ 4,000
From United Kingdom ...	9,000	9,000	—
,, United States	2,000	6,000	+ 4,000
Telephones and accessories.—			
Total	£ 39,000	116,000	+ 77,000
From United Kingdom ...	28,000	33,000	+ 5,000
,, United States	8,000	55,000	+ 47,000
,, Sweden	3,000	7,000	+ 4,000
,, Belgium	—	27,000	+ 27,000
Iron telegraph and telephone wire.—			
Total ... ...tons	24	400	+ 376
£	646	27,000	+ 26,354
,, United States ...tons	24	190	+ 166
£	646	7,000	+ 6,354
,, United Kingdom ...tons	—	200	+ 200
£	—	20,000	+ 20,000
Gas, oil, and hot-air engines, other than for traction.—			
Total	118,000	141,000	+ 23,000
From United Kingdom ...	62,000	87,000	+ 25,000
,, United States	50,000	49,000	– 1,000
Steam engines over 1,000 i.h.p.—			
Total	6,000	2,000	– 4,000
From United States	6,000	2,000	– 4,000
Steam engines, 1,000 i.h.p. and under.—			
Total	13,000	22,000	+ 9,000
From United Kingdom ...	9,000	19,000	+ 10,000
,, United States	4,000	1,000	– 3,000
Steam boilers, over 500 i.h.p.—			
Total	2,000	16,000	+ 14,000
From United Kingdom ...	2,000	16,000	+ 14,000
Steam boilers, 500 i.h.p. and under, feed-water heaters, &c.			
Total	28,000	27,000	– 1,000
From United Kingdom ...	28,000	25,000	– 3,000

THE ELECTRIC FLOW METER.

At a meeting of the Southern Association of Gas Engineers and Managers, on November 23rd, Mr. John Terrace read a paper describing a meter for the measurement of the output of gasworks, in which electricity is the medium of registration. Fig. 1 shows the principle of the meter diagrammatically. An orifice plate of Monel metal is inserted in the gas main and the pressure in the pipe on one side of the orifice plate is made to balance the pressure on the other side by raising the mercury in the container marked "V." The mercury column forms part of an electric circuit which contains a fixed external resistance R^1 in series with a variable internal resistance R^2, a constant electro-motive force E, an ammeter A, and a watt-hour meter W. In the contact chamber C_1 which forms the low-pressure side of the U tube, there are a number of conductors of varying lengths placed above the mercury column, and as the mercury rises it makes contact with one conductor after another. The variable resistance R^2 is subdivided by these conductors into resistance steps, so that the rise and fall of the mercury column varies the

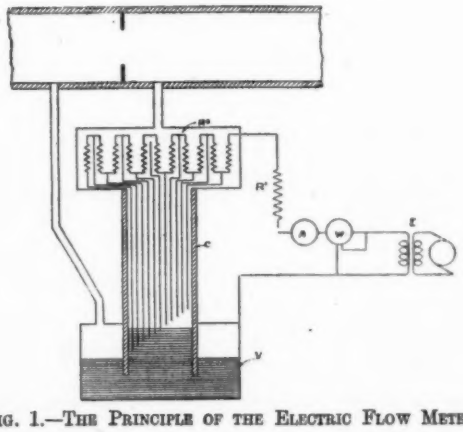


Fig. 1.—The Principle of the Electric Flow Meter.

amount of resistance, and therefore regulates the amount of current passing through the circuit. Moreover, the resistances are so divided that the flow of the current in the circuit is directly proportional to the flow of gas in the pipe, so that the electrical instruments, while measuring the current regulated by the flow, actually register the amount of gas passing through the pipe. The total amount of electrical energy measured by the watt-hour meter is the equivalent of the total amount of gas passing through the pipe. Great

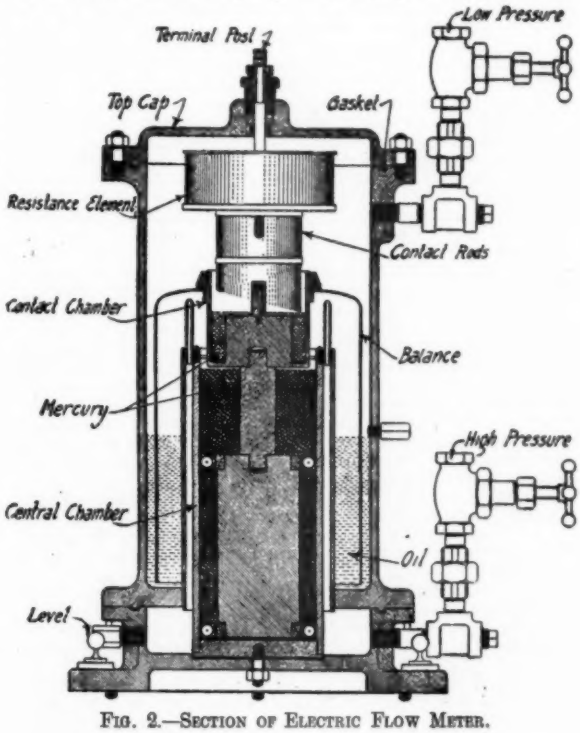


Fig. 2.—Section of Electric Flow Meter.

accuracy is ensured by using highly-sensitive electrical instruments, and by employing electricity to transmit the action to the reading instruments, all uncertain mechanical appliances, such as floats, cams, levers, gears, and stuffing boxes, are avoided. Fig. 2 shows a section of the meter body, from

which it will be seen how the higher gas pressure acting upon the underside of the floating bell is balanced against the lower pressure on the top of the bell, and as the differential pressure increases and decreases, the bell rises or falls and varies the electrical resistance by the contact rods in the contact chamber. Alternating current at 40 V is used, and a voltage regulator is used to ensure a constant voltage, although in future meters this is likely to be dispensed with.

Three instruments are used with the meter. One indicates the rate of flow and another records this continuously. The third instrument is an integrating watt-meter. These instruments do not indicate in cubic feet. If the quantity of gas passing could be kept within the range of the indicator, and the specific gravity were constant, this could be arranged, but as the hourly quantity to be measured in winter so greatly exceeds the summer output, and as it is undesirable to alter the size of the orifice plate, it is more convenient to multiply the readings by a factor which is varied according to (*a*) the specific gravity (a very necessary operation when varying quantities of water gas are being added to the coal gas, as a variation from .450 to .550 in specific gravity would make a difference of approximately 9.5 per cent. in the meter reading); and (b) the weight being used on the bell and the temperature and barometric pressure. This is found to be quite simple in practice. We are indebted for the above notes and illustrations to our contemporary, *The Gas World*.

ELECTRIC ARC WELDING.

(*Abstracts of papers read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

Apparatus and Equipment.

By J. CALDWELL, M.I.E.E.

ARC-WELDING practice is in advance of theory, and, as usually happens in an empirical art, there is considerable divergence of opinion on many points which can only be reconciled by the establishment of exact knowledge. A greater knowledge of the physical foundations of the process is desirable as a guide for practical development, and as a basis for confidence.

The total voltage-drop between the electrodes is the sum of three terms: two at the contact surfaces between the electrodes and the gaseous conductor, and one in that conductor. The surface voltage-drops are fixed for any particular electrode material, while that of the gaseous conductor is proportional to its length. For variations in current, the electrode material and arc length being fixed, the contact-surface areas and the cross-section of the gaseous conductor automatically vary so as to keep the current density in each constant. The resistance of the whole arc therefore varies inversely with the current passing, and the arc is unstable in itself. It has been generally assumed that a projection of metal takes place across an iron arc, from positive to negative, but this not in accordance with welding practice. The question whether the transferred metal travels in the state of vapour, a fine spray, or otherwise, has been much discussed, and there are various opinions. That there is a definite projection is certain, for in overhead and vertical welding the iron passes against gravity from the electrode to the work.

It appears that there are two very definite openings for research on the welding arc, *viz.* (1) In what state does the iron cross the arc, and what conditions determine its transit? and (2) What is the distribution of voltage-drop in the iron arc? Another is: What are the quantitative relations of this transfer of metal to the electrical and other variables?

A figure of 15 volts for minimum welding-arc voltage-drop is derived from tests made with direct current, bare iron electrodes, and automatic feed of the electrode. With hand operation the voltage is always higher, *i.e.*, from 22 to 25 volts. Flux-covered electrodes appear to permit of a somewhat greater working length and voltage, thus rendering the manipulation easier. If the arc is lengthened much beyond the figures given, good welding is impossible. The open-circuit voltage must be in considerable excess of the arc voltage to provide for the voltage-drop in the steadying resistance or reactance required to make the circuit reasonably stable, and also to permit the arc to be struck readily. Facility of striking the arc is an important element in the time and labour cost of arc welding.

Good welding can be done with both direct and alternating current. Flux-covered electrodes are essential for alternating current, apparently because the lagging effect of the flux and slag maintains the necessary temperature during the periodical current reversals. A higher open-circuit voltage is required with alternating current. With direct current an arc can be maintained with a minimum of 45 volts (open circuit), but 60 volts is much easier to work with, and can be taken as the practical figure. With alternating current the open-circuit voltage should be from 75 to 90 volts. The difference between the arc voltage and the open-circuit voltage has, in the case of direct current, to be taken up in a steadying resistance, while a reactance is used with alternating current.

With bare electrodes there is oxidation of the electrode itself beyond the arc, and of the weld metal and work whilst they are hot. A suitable flux covering protects the electrode beyond the arc, forms a protective slag on the deposited metal and work, and reduces the access of air to the arc itself. A flux coating plays a very important part in welding high-carbon steels and alloy steels and cast iron, where it is necessary to obtain weld metal approximating in composition and structure to those materials. The metallurgical and chemical actions of the coating and the flux formed by it have to be reconciled with other requirements, *e.g.*, the coating must fuse at a slightly higher temperature than the metal, while the slag formed must be very liquid and light so that it will rise to the surface before the metal solidifies and will spread over the hot weld and so protect it from the air.

The current required for welding depends mainly upon the thickness and mass of the parts to be joined. It may be said roughly that the dimensions of the work determine the current, and the current determines the size of the electrode. For coated electrodes the maximum currents range from 60 amperes for No. 14 gauge to 200 amperes for No. 4 gauge. The current densities thus vary from about 12,000 amperes per sq. in. for the smaller, down to about 5,000 amperes per sq. in. for the larger. The American practice, which is chiefly with bare electrodes, is to use from 10,000 to 12,000 amperes per sq. in. An electrode is capable of welding properly with two-thirds or less of the maximum current. Whether automatic welding will permit of larger values has not yet been determined. Automatic arc welding is hardly beyond the experimental stage in commercial service.

It is the established practice to make the work positive and the electrode negative. With iron electrodes the reason for making the work positive is that, as more heat is evolved at the positive electrode, the greater conductivity of the work is countered and the work surface raised to the fusing point with a smaller current than would otherwise be necessary.

For general-purpose direct-current single welders the maximum loading is 200 amperes at 60 volts. This current is about as large as can be managed in hand operation. Regulation is the special problem of the single-welder set. The requirements may be summarised as follows:—(1) A drooping characteristic for any current beyond that fixed by adjustment; (2) a uniform voltage for currents up to the set or adjusted load, with little or no increase at no load; and (3) very rapid regulation to counter the effect of arc variations. The devices employed with more or less success to meet these requirements can be roughly classified as follows:—(1) Excitation methods; (2) regulation of speed or torque of driving engine or motor; and (3) external regulators controlling resistances in the welding circuit. In addition to those automatic regulations it is always necessary to provide an adjustable resistance to suit the current needed for the particular work in hand. The ideal set would require only this one adjustment, the automatic devices keeping the output at that level.

The paper describes, with diagrams, several machines proposed to give characteristics meeting the requirements of arc welding by automatic variation of excitation.* These include the Kramer type adopted for the Premier set; the Macfarlane type, used in the A. W. P. set; the American Westinghouse and General Electric types; and the Mawdsley machine. The only welding machine known to the author which regulates by drive is the Davies-Soames set, using a magnetic clutch. The Wilson equipment used with welding circuits paralleled on one generator has a carbon-pile resistance regulator controlled by a spring and solenoid in each welding circuit.

There is a somewhat general opinion among welders that the stabilising resistances in direct-current welding are improved by the addition of a certain proportion of reactance. It seems more logical to provide the reactance in the generator itself, particularly in the form of armature self-induction. Flux-covered electrodes give smaller fluctuations than bare electrodes and at least reduce the need for external reactance.

It may be assumed that alternating current will always be taken from a public or works general supply and transformed to the welding voltage. Welding is a single-phase load with a lagging power factor, and if the supply is three-phase the welding current disturbs the balance of the phases. This can be met to some extent where a number of welders are in use, by dividing them between the phases, or single-phase current can be taken from a three-phase transformer by the well-known method of connecting the secondaries in series with one winding reversed. Alternating-current welding requires 75 to 90 volts on open circuit. The difference between this and the arc voltage is taken up by means of a reactance

* An exhaustive paper on "The Design of Constant-Current Generators for Arc Welding," by Mr. K. L. Hansen, appeared in the *Transactions* of the American Institute of Electrical Engineers, 1920, Vol. 39, part 2, p. 1,357.

in the circuit. The capacity of single-welder sets for a full range of welding is 12 kVA. For multiple-welder sets the transformer capacity may be less, say from 6 to 8 kVA per welder served. The open-circuit voltage required for a.c. welding may, in some working conditions, be dangerous. To prevent this danger, apparatus has been devised which reduces the open-circuit voltage to 25 volts and also facilitates the striking the arc. The Holslag welding transformer (A.C. Cutting and Welding Co.) is a combined transformer and choke coil, with mutual inductance and a common leakage path between the two elements. The Davies-Soames automatic regulator (Daysohms, Ltd.) resembles a wound-rotor induction motor, and gives a very nearly constant current, with a sharp voltage drop if that current is exceeded. A safety device reducing the open-circuit voltage to 25 volts has been devised by Daysohms, Ltd.

As the result of recent research work, four types of electrodes are now available for the purpose of welding and depositing non-ferrous metals. The metal core is of tinned copper, surrounded by a flux covering, which adheres firmly to the welding rod and does not break away when subjected to transport and workshop usage. This flux covering is of special composition to suit the nature of the copper alloy to be welded, and produces a powerful reducing atmosphere around the work to ensure the deposition of good metal in the weld.

AN INVESTIGATION OF THE IRON ARC, BY H. M. SAYERS, M.I.E.E., AND F. M. SAYERS.

This formed an appendix to Mr. Caldwell's paper, and the apparatus used was re-erected at the Institution and demonstrated. This consisted of a horizontal iron arc, fed by suitable arrangements, throwing an image by means of a lens on to a screen. A shutter rotated by a synchronous motor was fixed between the arc and the lens, and the stator of the motor was rotatable about its own axis, so that the phase at which the arc was "imaged" could be varied. In prior experiments arrangements for photographing the arc were made. The frequency was 50 cycles, the open-circuit voltage of the transformer was about 68, the steadying impedance was partly a choking coil and partly a resistance, the electrodes were No. 14 S.W.G., closely wound with asbestos yarn coated with a flux compound, supplied by Alloy Welding Processes, Ltd., and the current was approximately 30 A.

The following is a description of the phenomena observed. With the shutter stationary, one sees that the surface of the work is hollowed and rippled, the ripples being roughly concentric and moving outwards towards the rim of the crater. The crater surface appears to be of clean, molten metal. Surrounding it there is a red-hot rim of matter in ebullition, presumably molten slag. At the end of the electrode the covering melts with a steady rotation at the rate of four or five revolutions per second. The molten covering forms drops at the lower edge of the electrode, parts of which fly across to the work at frequent intervals. The path appears to be outside the vapour body.

The arc or vapour mass is of no very definite or constant form, and rapidly changes shape. At the electrode end it appears to be of rather larger diameter than the electrode, and apparently an overlap of it rotates and removes the covering, as described above. It narrows at the work end and seems to terminate on a very bright part of the crater on the work, a patch smaller than the electrode diameter, and of irregular and changing shape. Between the two the arc expands a good deal on the upper side, but not so much on the lower side. It gives the impression that, but for the effect of gravity, it would take a spherical shape, but with a somewhat large segment cut off by the electrode boundary. The colour of this arc is a blue violet, and there is no appearance of any drops or particles traversing it. To the eye it is not brighter than the electrode and work surfaces, but the colour of the latter is bright red to orange, or nearly white, while that of the arc is blue, as stated. Photographed without any colour screen, the arc is far brighter than anything else excepting the bright patch where it seems to terminate on the work crater.

Photographed on a dropping plate (with the shutter open and stationary) the arc shows as two bright patches per period. The width of these patches corresponds to about two-thirds of an alternation; and they are brightest in the centre, shading off to a sharp edge. The image of the bright spot on the work crater is nearly continuous, but is not so bright.

Observed visually with the synchronous shutter and a certain position of the stator, the appearance is not materially different from that obtaining with no shutter. On rotating the stator, *i.e.*, altering the phase of the shutter opening, the blue vapour mass fades and finally, for a space centred on a 90° angle from the maximum arc size and brightness, the vapour mass disappears. The electrode end and the work crater surface are seen glowing, and the surrounding slag boiling, the inference being that the arc is extinguished, or the blue vapour mass non-existent, for a definite interval on either side of the zero-current points.

Oscillograms have been made, using the falling-plate method. The open-circuit voltage is approximately sinusoidal. The voltage curve with the arc established has much steeper sides and a broad two-peaked maximum. The arc current curve is a triangular peak with a base of about two-thirds the duration of each alternation. The other third is at zero value. This duration corresponds to the falling-plate photograph of the arc, and appears to mean that the current passes only while the vapour body is in existence. Presumably the current is interrupted and the arc stops at some point in the descent of the voltage, and both are re-established on the following reverse rise of the voltage. It is clear that the arc duration in each alternation corresponds to that of the peak of the voltage curve, the valley between the two peaks of the voltage maximum to the rapid rise of the current, and the rise to the second peak to the rapid fall of the current.

Only visual observations have been made with a small direct-vision spectroscope. These show a bright-line spectrum of the arc body, which seems to be chiefly the arc spectrum of iron, though the sodium *D* line is strong, doubtless from the flux composition.

With an image of the arc in a nearly stationary position on a screen, it seems possible to investigate the temperature distribution by a thermopile or other means of measuring radiation. This has not, however, yet been attempted.

The observations made do not justify any decisive statement as to the way in which the iron is transferred from the electrode to the work. They seem, however, to indicate that the arc body is chiefly iron vapour at a temperature considerably above the melting point of the metal. It is possible that this vapour body sheathes and masks a stream of very fine droplets of molten iron, but so far nothing of the kind has been observed. The molten flux-covering does visibly pass from the electrode to the work in fairly large drops, but, as above stated, outside the arc, and below it in the case of vertical welding. The current oscillograms are symmetrical above and below the zero line, *i.e.*, they indicate no difference due to the reversing polarity of the electrode and the work.

It would obviously be easier to observe any such difference as shown by the arc image with direct current, and it is recognised that the investigations described are incomplete without working on direct-current welding arcs.

One of the measurements which it is hoped to make with the help of the apparatus described is the quantity of iron deposited per unit of current and time, or per unit of energy in the arc. This, again, should be observed with both alternating and direct currents, and with varying electrode sizes and currents.

The literature of the subject contains a number of statements on this point, but they vary so widely that one can only suppose that they were made under widely varying conditions and they are not comparable. Mr. Langdon Davies has kindly furnished some results of tests made by him. With a No. 8 electrode and direct current he found a deposit of 157.8 grammes per kilowatt-hour, the energy being measured at the input side of a motor-generator. With alternating current he obtained with the same size of electrode a deposit of 315.5 grammes per kilowatt-hour, when the open-circuit voltage of the transformer was 55; and 351.0 grammes per kilowatt-hour when the open-circuit voltage was 45. The energy measurements in this case also were made on the input side of the transformer. As the energy includes the converting and transforming losses, it is obvious that the deposit per unit of arc energy must be higher. The greater weight per kilowatt-hour with alternating current is naturally due to the fact that the motor-generator losses were much higher than the transformer losses. The improvement in depositing efficiency due to reducing the open-circuit voltage from 55 to 45 of course means smaller impedance losses between the transformer and the arc. These figures appear to suggest that the deposit per kilowatt-hour of arc energy is of the order of 800 grammes. If it is the case that the iron is transferred as vapour, then there is a limit fixed by the vaporisation heat of iron. Evidently not all the iron volatilised at the electrode is deposited on the work, and the losses by oxidation, condensation, &c., are likely to vary to a large extent with the working conditions. Thus the oxidation losses should be higher with small electrodes than with large, supposing similar current densities, as the ratio of the surface to the mass of the vapour or arc body is greater in the case of the smaller electrodes and currents.

One instrumental difficulty in measuring the arc energy is that there are no integrating meters on the market for voltages in the neighbourhood of 20 volts, and an integrating meter (or the integration of voltage and current oscillograms) is the only practicable way of measuring the rapidly-fluctuating energy in a welding arc.

The authors desire to acknowledge much assistance and encouragement from Mr. Langdon Davies, as well as from Major Caldwell.

DISCUSSION IN LONDON.

After reading his paper at the Institution, on December 14th, Major Caldwell exhibited thirty or forty lantern slides showing the wide field to which electric arc welding was now applied. The slides showed the construction of buildings, gasholders, boilers, &c., and repair work upon ships, engines, boilers, transformer tanks and numerous other applications.

Mrs. AYRTON, author of the well-known treatise on the electric carbon arc, opened the discussion, stating that the paper seemed to show that there were many points of similarity

between the carbon and iron arcs. In her studies of the carbon arc she had found that there was a short length of higher resistance adjacent to the crater of the positive electrode. She compared the arc with steam issuing from a kettle; close to the spout there was nothing to be seen, but outside this the condensed steam was visible. In the electric arc there was a short length of carbon vapour, and this appeared to be converted into a carbon "mist," due to the cooling effect of the gap between the electrodes. There appeared to be no actual transference of substance apart from this mist. With direct current the negative electrode remained much cooler than the positive, but with alternating current the temperature was equal, leading to quicker and easier volatilisation.

MR. H. M. HOBART said that although flux-covered electrodes were now used almost exclusively in this country, in the United States 95 per cent. of the arc welding was done with bare-wire electrodes. This suggested that the covering was not absolutely essential. The paper would arouse great interest in the United States where they would be glad to hear of methods not usually employed there.

Dr. C. H. SHARP, introduced as a visitor from the United States, said that as a member of the American Institute of Electrical Engineers it gave him great pleasure to hear such an excellent paper read at the older Institution. There was a moral to be drawn from this subject of welding. It was that the two great countries should be more closely welded together—and he thought it could best be done electrically—by the co-operation of the electrical men of both nations.

Mr. C. R. DARLING said that the Admiralty Welding Research Committee, over which he presided during the war, had learnt much from the United States, and he hoped that the latter had been aided by the Committee. Little was known of the physical properties of the arc. The almost universal use of bare-wire electrodes in the United States suggested that the matter should be further investigated. He believed that there was a great deal of superfluous material put on electrodes which added considerably to their cost. The chemical side of welding needed more attention. He had found that two welds made on the same plate, with the same arc, and by one operator, had widely different tensile strengths. He did not think that there was any actual projection of material in the arc; vapour would be heavier than air and this would render overhead welding impossible.

Capt. R. J. WALLIS-JONES said that the author had given an excellent review of the present state of the art. He read an extract from a note on electric welding in the *Encyclopædia Britannica* by Prof. Elihu Thomson, which suggested that globules of fused metal were projected and converted into vapour, thus effecting the transference of metal. The author had said the automatic welding machines were in their infancy, but the speaker instanced two American machines which had rendered satisfactory service—the "Lincoln" and a machine made by the General Electric Co. Capt. Wallis-Jones referred to the important services rendered by Major Caldwell during the war, and also to the scheme evolved by Major Caldwell for training ex-service men as welders in a period of three months. He asked that copies of two important reports on welding by the author might be placed in the Institution library.

MR. W. MCCLELLAND also testified to the author's war services. One important development made during the war was the use of electric arc welding for repairing ships. The speaker mentioned an instance of the repairing of a ship in six or seven weeks by welding, whereas older methods would have occupied three or four months. The demonstration of Messrs. Sayers showed that the main arc was surrounded by a cylinder of molten flux, which was a great advantage when comparing flux-covered with bare-wire electrodes. The author said that if the arc was extended beyond a certain length, corresponding to from 27 to 30 V, porosity would be apparent in the deposit. The speaker thought that this depended to a great extent upon the type of electrode used, and the voltage was generally higher—from 30 to 40 V. Alternating-current welding was very little superior to d.c.; a.c. welds did not possess the same uniformity as d.c. The importance of generator design had been somewhat overrated; any flat-compounded generator giving from 60 to 70 V was suitable. A skilled operator was certainly necessary.

MR. E. B. WEDMORE said that the Electrical Research Association was very interested in the work, and would gladly co-operate in any developments.

MR. H. M. SAYERS exhibited, on the screen, oscillographs of the welding pressure and current. The pressure had two distinct peaks, and in the depression between these the point of maximum current was reached. Referring to the spectra of the arc at various stages, the speaker said that at the maximum voltage the spectrum was practically an iron spectrum with dark sodium lines. This suggested that the iron was present as a gas, not as a liquid. The sodium lines indicated an enveloping sheath provided by the flux. This guarded against oxidation, and also formed a bridge, preventing the extinction of the arc at points of zero voltage. There was not so much a.c. welding done in the United States as in this country; this probably accounted for the extensive use of bare-wire electrodes. He hoped shortly to investigate temperature distribution in the arc. He had found that a kWh of electricity would evaporate 750 grammes of iron.

Here the President asked any other members desirous of contributing to the discussion to communicate in writing.

MAJOR CALDWELL, in the course of a brief reply, said that, generally, American welded work was not so good as British, although electric welding had been employed in the United States for a longer period. The shortage of oxygen was the principal factor leading to the introduction of electric welding during the war. He considered that a reversion to the use of bare-wire electrodes would be a retrograde step.

RADIO-TELEPHONY ON TRANSMISSION LINES.

The System of the Société Francaise Radio-Electrique.

IN many electrical undertakings the establishment of permanent, certain, and instant communication between the principal departments is one of the chief concerns of the officials.

Owing to the impossibility of relying on the French state-owned telephone system, which is slow, not always in operation, and not always available near the power stations and networks, several companies have been led to construct special telephone lines, often using no other supports than those already existing for other purposes, such as the State lines or power transmission lines.

The initial cost and the cost of maintaining such installations is very high, and they do not give complete security. This is particularly true in the case of power transmission networks. When there is a break in the high-pressure line the telephone line is usually damaged and put out of use, just at the time when it is most necessary; moreover, the inductive effect of the power lines on the telephonic network creates in the latter permanent troubles harmful to the apparatus, and adversely affecting the efficiency of transmission.

The Société Francaise Radio-Electrique claims that the perfect operation which it has obtained with wireless telephony affords a remedy for all these troubles, and gives officials reliable communication at small cost and free from the drawbacks above-mentioned.

The company has made and used a valve-pattern wireless telephone, type F.D.C.O., of small power. This apparatus gives all the usefulness and security of the ordinary telephone with wires, employing very little power, and, being very simple to use, it can be put in the hands of anyone after a short demonstration. Also, the F.D.C.O. set is very economical, so much so that the cost is covered by the saving in the cost of working—valuable qualities if we consider, in comparison, the cost of installing and maintaining a private telephonic network.

The F.D.C.O. set can be connected to a fixed aerial, and ensures good communication to a distance of 30 kilometres if the aerial has a mean height of at least 15 metres. It also forms a small portable and very light outfit, the aerial being fixed on a telescopic mast 12 metres high.

It lends itself very well to the utilisation of the power transmission network, part of the waves sent out by the aerial placed near the line being collected by the latter. The transmission of intelligible speech is maintained, even if the power lines are accidentally broken and fall to the ground; the waves leaving the broken line jump through the intermediate space, and are picked up by the other end.

Speaking more generally, in all cases where several places are joined by a conductor, even a discontinuous one, the F.D.C.O. set can be used to obtain a range very much superior to the normal compass. It can be connected with advantage to the wires of overhead or submarine telephones. In spite of the small power, its range is then 100 kilometres.

In all cases the apparatus is put into service with the facility of the ordinary telephone (call by bell, put in action by the unhooking of the combined receiver, transmission and reception simultaneous).

An F.D.C.O. installation consists essentially of a transmitter and a receiver connected to the aerials for transmission and reception. In the case of transmission along a high-pressure overhead power line, the aerial consists of two wires carried parallel to the line for a length of 100 to 125 metres, at a distance of 1 to 2 metres, in such fashion that they cannot under any circumstances even accidentally

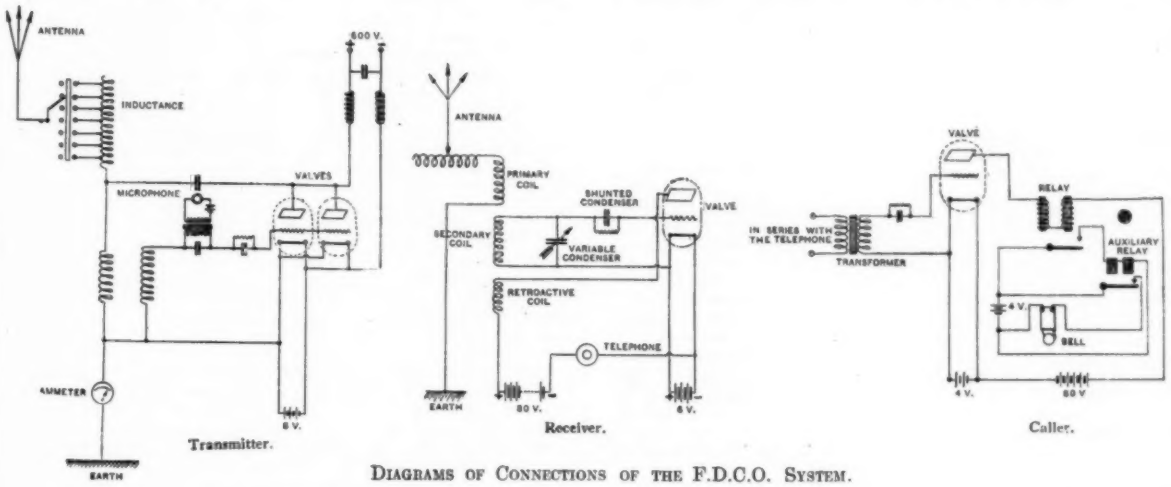
come in contact with the live wires. There is no connection between the network and the apparatus.

In order that the stations may hear each other they must be tuned to the same wave-length.

In the case of an undertaking comprising several stations, one allots to each station a predetermined wave-length, to which its receiver is regulated once for all. To converse with this station it is necessary to transmit on its own wave-length; transmission on a different wave-length is not noticed, and cannot trouble it.

These proceedings can be simplified if the stations are furnished with call indicators.

The call-bell is connected so as to continue ringing after once starting, until the receiver is lifted. It is therefore not necessary to have someone continually on watch near the apparatus. But where a station can be called by several others it is necessary that the call should be accompanied by an indication of the calling station. To accomplish this, a supplementary fitting, called a call indicator, has been designed, by means of which the ringing of the bell is accompanied by the illumination of a small lamp indicating the calling station.



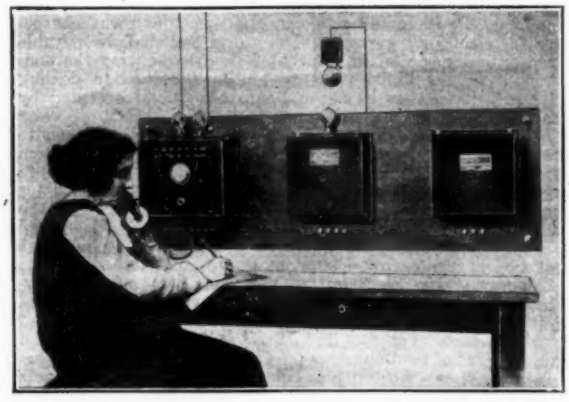
DIAGRAMS OF CONNECTIONS OF THE F.D.C.O. SYSTEM.

The transmitter permits of the use of seven different wave-lengths, which can be changed by pushing a plug into one of the seven holes provided. These wave-lengths correspond to those of the different receiving stations of the network. All the wave-lengths are regulated, once for all, at the first installation of the network.

The receiver is completed by a caller with a bell, which gives notice when the station is called. The bell is arranged to ring on the wave-length for which the receiver is tuned, but on no other.

The accompanying diagrams will help to explain the operation of the apparatus: transmitter, receiver, and caller.

The energy necessary for the operation of the system is furnished by a converter set supplied either directly from the network or from a battery, in order to have an installation capable of working even in the case of the failure of a section.



AN F.D.C.O. RADIO-TELEPHONE STATION.

Telephonic communication with F.D.C.O. sets is said to give greater security than does the ordinary telephone, especially in the case of transmitting along a power line. To emphasise the simplicity of their operation, the method of use is indicated below :—

To call a station :—

Fit the plug on the transmitter into the hole corresponding to the station it is desired to call.

Press the call-button for about 10 to 15 seconds.

Unhook the receiver and give your name (rather than say " Hallo ").

To reply to a station :—

When you hear the bell, unhook the receiver and listen. When you hear the name of the calling station, fit the plug on the transmitter into the corresponding hole and answer.

The call-button on the transmitter is replaced by a call dial. This consists of a small disk which automatically produces signals of a predetermined rhythm (a letter of the Morse alphabet).

The call indicator consists of several relays which are put in action by the signals received. To each letter of the Morse alphabet corresponds a lamp, which is illuminated when that letter is received.

The whole of the apparatus described above is made by the Société Francaise Radio-Electrique for a network of eight stations as a maximum. But the company can, if necessary, establish more important networks without having to solve any new technical problems. In the case of large networks it often happens that not all the stations need to be able to communicate with each other; the network can then be divided into sections, of which only the central stations are able to communicate with the corresponding stations of the other sections. In this case the standard equipment is perfectly suitable.

Where communication is necessary over a greater range than can be obtained with the F.D.C.O. sets, the company can supply similar sets of greater power.

This system is installed at the power station of the Société des Mines de Lens at Pont-à-Vendin, which was visited by the ELECTRICAL REVIEW party during the French tour in October last year; the messages are sent into the high-pressure transmission lines in the manner above described, and are received at the sub-stations in the same way. The members of the party were greatly interested in the device, which was understood to be perfectly satisfactory in operation.

Electric Echo Sounding.—M. Langevin, whose invention of electric apparatus enables vessels to discover the nearness of land, or the presence of obstacles beneath the surface of the water without taking soundings, states that he has based his work upon the experiments of the English navigator Richardson. He has succeeded in producing so-called ultra-sonorous waves, which escape the ear, but which, emitted vertically through the water, or horizontally on the surface, strike the land, or such obstacles as sunken rocks, and are reflected as by an echo. It is sufficient to calculate the interval between the emission of the waves and the echo to decide the distance of the obstacle. The difficulty was to transform high-frequency electric waves into the elastic ultra-sonorous waves required, and this is M. Langevin's discovery. The waves are transmitted in the water at a speed of 1,500 metres a second. A spark emitted by an ordinary radio installation being translated into ultra-sonorous waves, and the echoes, on being thrown back, are transformed into an electrical oscillation, which is recorded by the same radio instrument. Soundings have been made by this means at a depth of many thousands of feet.—*Daily News.*

THE WORK OF THE ELECTRICITY COMMISSIONERS.

SECOND ANNUAL REPORT. *(Abstract.)*

IN presenting their second annual report (for the year ended March 31st, 1922)* the Electricity Commissioners refer to two factors which have had a material bearing upon the course of events during the past financial year, namely: (*a*) the severe industrial depression which prevailed throughout the year; and (*b*) the uncertainty which existed as to the date and scope of the further legislation necessary to enable full effect to be given to the policy of re-organisation laid down in the Electricity (Supply) Act, 1919. The effects of the industrial situation upon electricity supply have been characterised by a general decrease in the demand for power supplies and hence in the aggregate output; owing also to the uncertain outlook and thus to the natural hesitancy to embark upon substantial developments, there has been a retardation during the past year in the rate of growth of the supply industry as a whole. Considerable attention was devoted by the Commissioners to the investigation of various proposals for the relief of unemployment by stimulating developments in the electricity supply industry. While the framing of the unemployment legislation was under consideration, such of the above-mentioned suggestions as appeared to the Commissioners to be of practical value in the emergency were put forward. The absence of powers such as those sought by the Supplementary Bill has not only been felt by authorised undertakers and others engaged in the preparation of schemes for the re-organisation of electricity supply and upon plans for individual development, but has imposed a restriction upon the progress possible by the Commissioners in giving effect to certain schemes of re-organisation. The uncertainty characteristic of a period of impending legislation has also been apparent in other directions. But, notwithstanding the general depression, steps have been taken in numerous directions to improve the organisation for the supply of electricity in different parts of the country, and these steps should in due course have a beneficial effect upon the welfare of the country when trade revives generally. At the end of the period covered by the Report, there had been no material improvement in the condition of trade throughout the country, but signs were not wanting of a tendency towards a better state of affairs. The large capital requirements of Local Authority undertakers, as evidenced by the amount of the loans sanctioned by the Commissioners, taken in conjunction with the successful issues of capital by some of the larger company undertakers are not without significance in this connection. The electricity supply industry constitutes, to a peculiar degree, an index of the general conditions of home trade owing to the important and increasing extent of the applications of electrical power to industry. An improvement in the position of supply undertakings, coupled with a rising curve of output, will therefore constitute one of the first signs of an improvement in the condition of industry generally.

Authorised Undertakers.—Owing to the transfer to the Governments of Northern and Southern Ireland respectively of the administration of the General and Special Acts, Orders, Regulations, &c., relating to the supply of electricity in Ireland, and other changes the position with regard to local authorities, companies, and persons holding statutory powers of supply in Great Britain on March 31st, 1922, was as follows:—

TABLE I.

Powers held by—	England.	Wales.	Scotland.	Total. Great Britain.
Local authorities ...	251	41	23	315
Companies	173	17	22	212
Persons	4	1	2	7
Totals ...	428	59	47	534

Allowing, as before, for cases in which an undertaker held powers in more than one portion of Great Britain, the total number of authorised undertakers in Great Britain on March 31st, 1922, inclusive of those who had not then commenced to supply electricity, was 531. A complete list of these, giving salient particulars, is being prepared by the Commissioners for separate publication.

Non-Statutory Undertakings.—One feature of the existing organisation for the supply of electricity in this country is the large number of cases in which public supplies of electricity for lighting and other purposes are given by small undertakings established without statutory powers, the plant capacity of these ranging from a few kW to perhaps 200 or 300 kW in exceptional cases.

In other cases, public supplies to outside consumers and supplies in bulk to authorised distributors are given by the owners of factories, collieries and other industrial undertakings who have a certain amount of surplus energy available for disposal. There are also a number of important undertakings of considerable size which have been established without statutory powers mainly for the purpose of supplying energy in bulk to authorised undertakers, or for the purpose of converting waste heat into electrical energy for disposal to authorised undertakers. These installations are located in certain industrial areas, such as the County of Durham, and are in a somewhat different category from the small public supply undertakings previously referred to.

With regard to the small undertakings established for the purpose of giving public supplies, it has often been represented that the restrictions associated with statutory powers and the expense of obtaining such powers constitute a serious obstacle in the way of development. As regards the expense involved, the prescribed fee for applications for Special Orders under Section 26 of the Act of 1919, is £35, and in cases where the Commissioners cause a Local Inquiry to be held before coming to a decision, the applicants are required to defray the travelling and incidental expenses incurred on behalf of the Commissioners, which are as a rule small. Apart from those expenses, the applicants have to defray the cost of advertising, notices, printing, &c., and in general the services of a solicitor or Parliamentary agent are also found necessary for dealing with the promotion of the application and subsequent proceedings. The total expenses will, of course, vary according to local circumstances. It may be taken, however, that in the case of an unopposed and straightforward application, the total expenses of the promoters should not exceed about £300. The Commissioners have given some consideration to the question whether a simplified form of procedure for obtaining statutory powers could be devised to meet the case of very small undertakings with the object of minimising costs. The question, however, presents many difficulties and the Commissioners have found it necessary to defer the matter for the time being. The public interest is a matter which must not be lost sight of, and it should be noted that non-statutory undertakings are under no obligations to the public, and that the consumers supplied by such undertakings have none of the safeguards and rights enjoyed by the consumers of an authorised undertaking. The question of compiling a list of non-statutory undertakings in Great Britain is at present under consideration by the Commissioners.

Powers of the Commissioners.—In addition to the powers and duties vested in the Commissioners by the Act of 1919, and certain powers and duties under the Electric Lighting Acts quoted in the previous Report, the Commissioners were further authorised on July 18th, 1921, by the Minister of Transport to accept, for th epurposes of Orders granted to company undertakers under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, the certificate of any official auditor appointed by the Commissioners under the provisions of Section 6 of the Schedule to the Electric Lighting (Clauses) Act, 1899. In this connection it should be noted that Orders granted to company undertakers under the said Act of 1918 authorising a modification in the prices chargeable for electricity, provide that no dividend shall be payable upon ordinary capital in respect of any year during the continuance of the Order until an auditor's certificate dealing with certain matters has been furnished to and accepted by the Minister of Transport.

Re-organisation of Supply—Action Taken.—In addition to preliminary surveys leading to the provisional determination of further districts, the Commissioners have devoted a large amount of time to the consideration of schemes submitted for a number of districts, to the holding of local inquiries, to the weighing of the evidence given at those inquiries, and to the preparation of statements of decisions and conclusions and also of Draft Orders embodying approved schemes.

During the year the Commissioners have provisionally determined two electricity districts in Scotland, thus making a total of 15 districts provisionally determined up to the date covered by the Report. The two districts were the West of Scotland and the East of Scotland.

In addition to the schemes submitted for the five districts dealt with in the previous Report, the Commissioners have received schemes in respect of seven further districts. Inclusive of competing or alternative proposals, 23 schemes were lodged with the Commissioners for the twelve dirstricts in question. Of this number, 15 schemes for the re-organisation of supply also provided for the establishment of Joint Electricity Authorities, two schemes provided for the establishment of Advisory Boards, one scheme for the establishment of an Advisory Committee, and five schemes or proposals were mainly concerned with the re-organisation of supply from an engineering standpoint.

The Commissioners have held Local Inquiries in respect of six Electricity Districts, the time occupied by those inquiries amounting to 52 sitting days.

Statements were issued by the Commissioners embodying the conclusions and decisions they had arrived at as the result of three of the inquiries, and also as the result of the two inquiries referred to in the last Report, namely, at Liverpool, in respect of the Mersey and West Lancashire District, and at Llandudno in respect of the North Wales and Chester District. The adjourned inquiry held at Bristol in January, 1921,

* H.M. Stationery Office. Price 2s. 6d. net.

was not resumed, as the Organising Committee for the Lower Severn District notified the Commissioners in May, 1921, that on account of changed circumstances in the district, and for other reasons, the Committee would not be justified in proceeding further with its scheme for the formation of a Joint Electricity Authority. The evidence given at local inquiries at Manchester, Barrow and Wolverhampton was still under consideration on March 31st, 1922.*

The position with regard to the Electricity Districts provisionally determined by the Commissioners has been recorded in our columns as decisions have been published.

Approved Schemes.—Under the provisions of Section 5 (4) of the Act of 1919, the Commissioners are required to publish, in such manner as they think best adapted for ensuring publicity, any scheme which they have approved or have themselves formulated, and to hold a local inquiry thereon. It appeared to the Commissioners that it would be most convenient to all concerned if the approved scheme, for the purposes of the further inquiry, took the form of a Draft Order, as interested parties would thus have an opportunity of considering the scope and effect of the administrative, financial, and technical clauses, subject to possible amendments as the result of the further inquiry.

Draft Orders embodying the schemes approved by the Commissioners for four electricity districts were in course of preparation during the latter portion of the year 1921-22, and two of these Draft Orders, namely, for the North Wales and Chester district, and the South-West Midlands district were in an advanced stage at March 31st.

The progress made in giving effect to schemes of re-organisation has been slower than was anticipated by the Commissioners, and for this there have been several contributory causes. In the first place, the Act of 1919 does not confer financial powers upon Joint Electricity Authorities, and, owing to the uncertainty of the legislative position in this matter (due to the withdrawal in August, 1921, of the Electricity (Supply) Bill introduced into Parliament in April of that year), there were obvious difficulties in proceeding with the full details of a Draft Order for a scheme which could only be made fully effective by the inclusion of financial provisions. In the next place, the Commissioners found it necessary, with the object of securing uniformity as far as possible, to give careful consideration to the provisions contained in the various schemes submitted to them in respect of the different districts and also to other relevant provisions in various enactments, with the view of framing standard or model clauses for matters likely to be common to all or the majority of schemes for the re-organisation of electricity supply. Another factor which has operated in the case of some districts was the necessity for negotiations between the principal parties concerned, or between the parties and the Commissioners, with the view of the settlement of various matters as a preliminary to the drafting of an Order embodying an approved scheme. While the time thus occupied has given the appearance of slow progress, the results so far achieved cannot but have a beneficial effect during later stages and will probably be conducive to more rapid settlement in the case of other districts.

The decision of the Commissioners to accept the engineering proposals put forward for the North Wales and Chester District by the North Wales Power & Traction Co., Ltd., was conditional, *inter alia*, upon (i) the Commissioners being satisfied that the agreement proposed to be entered into between the company and the Aluminium Corporation, the owners of the Dolgarrog hydro-electric works, would be such as to safeguard the power supply therefrom to the company; (ii) the company satisfying the Commissioners as to its ability to raise the capital required for carrying out the technical scheme; and (iii) the consideration of the amount payable by the company in respect of back dividends.

An application made by the company in 1921 for a Government guarantee under the Trade Facilities Act, 1921, in respect of a loan to enable important sections of the technical scheme for the district to be commenced at an early date was referred by the Trade Facilities Act Advisory Committee to the Commissioners for consideration, and as the outcome of the report made by the Commissioners the Advisory Committee intimated to the company that they would be prepared to recommend a guarantee subject to the necessary powers for the full working of the scheme being granted. Numerous conferences were held by the Commissioners with representatives of the company to discuss the terms of the proposed agreement between the company and the Aluminium Corporation, and also the engineering, financial, and other conditions to which the company would be made subject under the scheme to be approved by the Commissioners for the re-organisation of supply in the North Wales and Chester District. Although every effort was made by the Commissioners to expedite these negotiations they had not been concluded at the date of the Report.

In the case of the West Riding (Aire and Calder) District, the Commissioners came to the conclusion, *inter alia*, that in order to ensure the most efficient use of existing generating plant and to avoid unnecessary expenditure on transmission lines, the district should be dealt with in two agreed areas, one being that which could best be supplied from the inter-connected existing municipal stations (area "A") and the other being the remainder of the district which should be supplied by the Yorkshire Electric Power Co., provided that all the inter-connected stations were worked under one control and for mutual assistance. It was also intimated that all the local authorities concerned and the power company should prepare, for the approval of the Commissioners, a scheme to simplify the position as to rights of supply and transmission or distribution within area "A." Following the issue of the decision each of the principal parties, namely, the Corporation of Leeds, the Conference of West Riding Local Authorities and the Yorkshire Electric Power Co., sought an interview with the Commissioners to discuss the above-mentioned matters, and in December, 1921, the Commissioners held a joint conference with all three parties. As the outcome of that conference the parties appointed a small Committee consisting of the city electrical engineers of Leeds and Bradford, and the engineer and manager of the power company, to investigate the question of "agreed areas" in all aspects and to report to their principals, the latter undertaking to submit their conclusions and decision to the Commissioners as soon as possible. Although the Engineers' Committee addressed itself to this matter without delay and met on numerous occasions, it had not been possible by March 31st to elucidate the complex questions involved.

In the statement of conclusions and decisions issued by the Commissioners in respect of the London and Home Counties District, reference was made to a number of matters upon which negotiations had taken place between some or all of the principal parties prior to and during the local inquiry. The matters in question concerned (i) the transfer by the London County Council to a Joint Electricity Authority of the powers vested in the Council of purchasing the company undertakings in the County of London in 1931, or thereafter at the expiration of subsequent periods of 10 years; (ii) the vesting by the Associated Companies constituting the London Electricity Joint Committee, 1920, Limited, of their generating stations in a Joint Electricity Authority, subject to an extension of tenure as distributors; and (iii) the vesting by the Conference of Local Authorities owning Electricity Undertakings in Greater London of their several stations in, or the operating of such stations under the direction of, a Joint Electricity Authority. In the early part of 1922 the principal parties had conferences with the Commissioners with the object of obtaining a fuller explanation of the bearing of various matters dealt with in the published statement of the Commissioners, and the Commissioners on that and subsequent occasions intimated their hope that the negotiations above referred to would be pressed forward and brought to a satisfactory conclusion at an early date.

It is important to note that definite progress with regard to technical developments has been facilitated in the case of all districts where schemes have been submitted and subjected to investigation at the first statutory inquiry. In several instances the Commissioners, when issuing their statements of decisions as the result of the first Local Inquiry, have invited the representative authorities in a district to set up an Advisory Committee with whom the Commissioners can consult upon matters affecting the development of supply pending the issue and coming into operation of the approved scheme for the district. This course has proved useful in securing the proper co-ordination of local developments during the interim period.

(To be continued.)

* Statements have since been issued in respect of these inquiries.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C.1.

34,409. "Electric lamps." L. S. Walton. December 18th.
34,415. "Morse practice buzzer." J. Allan. December 18th.
34,418. "Motor-car side lamp." J. F. Prince. December 18th.
34,426. "Head-lamps for motor-vehicles." E. Baxter. December 18th.
34,447. "Wireless telegraphy and telephony." E. Mallett. December 18th.
34,451. "Electric switch." J. Pownall. December 18th.
34,458. "Controllers for electric traction systems employing vacuum brakes." Vacuum Brake Co., Ltd., and G. Mitchell. December 18th.
34,475. "Electric horns." D. A. V. Rist. December 18th.
34,494. "Aerials for wireless installations." K. I. Goodman and W. R. Goodman. December 18th.
34,497. "Electric lifts, &c." Waygood-Otis, Ltd. (Otis Elevator Co.). December 18th.
34,498. "Electric lifts, &c." Waygood-Otis, Ltd. (Otis Elevator Co.). December 18th.
34,502. "Electrodes for welding, &c." C. E. Hill, H. D. Lloyd, and Whitecross Co., Ltd. December 18th.
34,503. "Prepayment electricity apparatus." Chamberlain & Hookham, Ltd., and S. James. December 18th.
34,507. "Electric switches." British Thomson-Houston Co., Ltd., and H. C. Hastings. December 18th.
34,508. "System of electrical distribution." British Thomson-Houston Co., Ltd. (General Electric Co.). December 18th.
34,521. "Self-induction coil." F. Adcock. December 19th.
34,522. "Transmitting device for wireless telegraphy, &c." K. E. Edgeworth. December 19th.
34,525. "Electric contacts or switches." Clear-Hooters, Ltd., T. S. Rogers, and W. J. Spicer. December 19th.
34,526. "Electric horns." Clear-Hooters, Ltd., T. S. Rogers, and W. J. Spicer. December 19th.
34,527. "Electric motors." Lancashire Dynamo & Motor Co., Ltd., R. S. McLeod, W. Stansfield, and A. P. Wood. December 19th.

34,542. "Tramcar body." H. G. Wood. December 19th.
34,544. "Globe fittings of electric lamps." F. W. Thorpe and Veritys, Ltd. December 19th.
34,557. "Seating register for tramcars, &c." P. A. Davey. December 19th.
34,583. "Electric-light fittings." J. Eggleston. December 19th.
34,587. "Electric connectors." H. J. Fisher. December 19th.
34,594. "Control of trains." A. R. Angus. December 19th.
34,624. "Electrical systems for signalling to moving trains." F. Murdoch and W. H. Murdoch. December 19th.
34,630. "Electric light installations." J. H. Runbaken and W. Torrance. December 19th.
34,632. "Locking apparatus for distributing-switch of electric lighting installations for motor-cars." Scintilla. December 19th. (Germany, January 5th.)
34,634. "Process for distribution of metals by electrolysis." P. A. Govaerts and P. N. Wenmackers. December 19th. (Belgium, December 19th, 1921.)
34,635. "Installations of self-inductances permitting to increase delivery of rectifiers of alternating current." E. C. R. Marks (Soc. S.A.A.E. Soc. Anon.). December 19th.
34,637. "Railway signalling systems." Automatic Telephone Manufacturing Co., Ltd., and A. E. Hudd. December 19th.
34,638. "Electro-magnetic receivers." Automatic Telephone Manufacturing Co., Ltd., and S. R. Smith. December 19th.
34,639. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., C. Gillings, and W. O. Passmore. December 19th.
34,640. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and C. Gillings. December 19th.
34,646. "Means for generating electric currents." G. Swann. December 19th.
34,653. "Automatic, &c., telephone exchanges." G. H. Janson. December 19th. (Sweden, December 20th, 1921.)
34,655. "Wireless signalling receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). December 19th.
34,656. "Control of trains." A. R. Angus. December 19th.
34,663. "Tumbler switches." B. W. Handley. December 20th.
34,673. "Electric signs, &c." C. H. Woodward. December 20th.
34,674. "Suspension of trucks and motors of tramcars, &c." E. Williams. December 20th.
34,702. "Illuminated signs." A. H. Brackensey and Franco-British Electrical Co., Ltd. December 20th.
34,724. "Electrodes." A. Lane. December 20th.
34,726. "Induction synchronous motors." M. Kawarada and T. Yamamoto. December 20th.
34,729. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and A. A. Pollock. December 20th.
34,747. "Galvanic batteries." Oldham & Son, Ltd., and W. D. Wilde. December 20th.
34,748. "Electrically-operated changing mechanism." C. R. Jones. December 20th.
34,760. "Electro-deposition of chromium." R. Grah. December 20th.
34,776. "Relays, &c." Barr & Stroud, Ltd., J. W. French, and W. Stroud. December 20th.
34,784. "Electric converting machinery." O. Ellefsen and Electric Control, Ltd. December 21st.
34,790. "Flexible pendant electric-light fittings." F. H. Wood. December 21st.
34,812. "Electric, &c., control of points, signals, &c." A. E. Spencer. December 21st.
34,821. "Current-limiting devices for wireless systems." C. B. Kersting and T. J. Platt. December 21st.
34,826. "Rotary current motors." A. R. M. Sankey. December 21st.
34,828. "Anti-shock fitting for electric lamps." T. F. Francis. December 21st.
34,836. "Junction boxes for electric distribution systems." W. T. Henley's Telegraph Works Co., Ltd., and E. E. Judge. December 21st.
34,837. "Electric incandescent lamps." General Electric Co., Ltd. December 21st. (Germany, December 21st, 1921.)
34,853. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). December 21st.
34,854. "Production of thermo-induction currents." E. Viz and M. Meinhardt. December 21st.
34,870. "Electrically-heated furnaces, &c." H. Wade (H. L. Dixon Co.). December 21st.
34,871. "Production of thermo-induction currents." E. Viz and M. Meinhardt. December 21st.
34,899. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). December 21st.
34,900. "Automatic electric circuit breakers." British Thomson-Houston Co., Ltd. (General Electric Co.). December 21st.
34,909. "Bonding of metallic-sheathed conductors for electric wiring systems." E. Long. December 22nd.
34,917. "Control of electric circuits." N. Fay. December 22nd.
34,923. "Mounting crystal detectors for wireless receiving apparatus." A. G. Allen. December 22nd.
34,928. "Automatic switches for electric current control." C. C. Smith. December 22nd.
34,938. "Electric heater elements." G. H. Ide and M. J. Railing. December 22nd.
34,940. "Manufacture of electrodes for arc welding." A. C. Hyde. December 22nd.
34,948. "Electric arc ignition apparatus." H. P. Amphlett and J. E. Lewis. December 22nd.
34,954. "Surface condensers." Akt. Ges, der Maschinenfabriken Escher, Wyss et Cie. December 22nd. (Switzerland, January 5th.)
34,959. "Magneto-electric generators." G. E. Bairsto. December 22nd.
34,961. "Switch-holders for electric lamps." F. J. Froome. December 22nd.
34,962. "X-ray apparatus." E. E. Greville and F. W. Read. December 22nd.
34,964. "Electric signalling." H. P. Rogers. December 22nd.
34,980. "Electric timing-gear for internal-combustion engines." W. L. T. Arkwright and Tungsten Manufacturing Co., Ltd. December 22nd.
35,003. "Electric lighting and starting installations on motor-vehicles, &c." W. H. Glaser and C. A. Vandervell & Co., Ltd. December 22nd.
35,004. "Motor-vehicle lamps." A. J. Curnow and Howes & Burley, Ltd. December 22nd.
35,006. "Interrupters for electric ignition systems of internal-combustion engines." J. H. Runbaken and W. Torrance. December 22nd.
35,008. "Time switch for electric circuit." W. T. Anderson and A. B. Ballance. December 22nd.
35,033. "Electric switches." British Thomson-Houston Co., Ltd., and H. Trencham. December 23rd.
35,034. "Electric current amplifiers." British Thomson-Houston Co., Ltd. December 23rd. (United States, December 28th, 1921.)
35,035. "Control of dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). December 23rd.
35,050. "Electric insulators." W. H. Eccles. December 23rd.
35,054. "Headlights of vehicles." J. Ayer. December 23rd.
35,061. "Distributors, &c., for controlling electric circuits." F. H. Grove. December 23rd.
35,068. "Telephone receivers." J. Hester. December 23rd.
35,079. "Electric switches." J. A. Crabtree. December 23rd.
35,094. "Searchlights, &c." G. A. Hughes. December 23rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

16,369. "Motor mechanism with special reference to switch arrangements for automatic telephone systems." T. Lenaghan. June 14th, 1921. (189,822.)
16,370. "Metering or registering means with special reference to automatic telephone systems." T. Lenaghan. June 14th, 1921. (189,823.)
16,371. "Automatic telephone systems." T. Lenaghan. June 14th, 1921. (189,824.)
18,823. "Magnetic material and its use for loading telephone and telegraph conductors." Western Electric Co., Ltd. (Western Electric Co. Inc.). July 12th, 1921. (Addition to 188,688.) (189,832.)
20,688. "Insulating means for high potential condenser terminals and the like." W. Dubilier. February 18th, 1921. (175,595.)
20,928. "Glands of electric joint boxes." C. J. Beaver and E. A. Claremont. August 6th, 1921. (Cognate application, 3,423/22.) (189,840.)
20,943. "Automatic switching arrangements for telephone exchanges and the like." H. Baron (F. Aldendorff). August 6th, 1921. (Cognate application, 23,869/21.) (189,841.)
22,906. "Incandescent electric lamp." K. Nishimoto. August 29th, 1921. (189,847.)
23,348. "Apparatus for projecting a beam of light, especially applicable for aiming guns." L. G. Willis (E. D. Neff). September 2nd, 1921. (189,851.))
23,453. "Holders for electric lamps." A. B. Goldsmith, and Proprietary Smallwares, Ltd. September 3rd, 1921. (189,855.)
23,523. "Switch for controlling electric circuits." W. J. Pritchett. September 3rd, 1921. (189,857.)
23,604. "Armatures of dynamo-electric machines." G. H. Fletcher, and Metropolitan-Vickers Electrical Co., Ltd. September 5th, 1921. (Cognate application, 33,657/21.) (189,861.)
23,676. "Dynamo-electric machines." Electro-Dynamic Construction Co., Ltd., and N. Pensabene. September 6th, 1921. (189,862.)
23,973. "Sound-conducting tubes." H. Baron (Signal Ges.). September 8th, 1921. (Convention date not granted.) (168,910.)
24,057. "Electric arc lamps and other electrical discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). September 9th, 1921. (189,878.)
24,071. "Electrodes for electrolytic measuring instruments." Schott and Gen. September 17th, 1920. (169,163.)
24,250. "Manufacture of depolarisers for galvanic elements." R. Pörscke. September 12th, 1921. (189,889.)
24,654. "Electrical contact-breakers." British Lighting and Ignition Co., Ltd., and E. B. Tuppen. September 16th, 1921. (189,909.)
24,926. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. September 20th, 1921. (189,903.)
25,027. "Electric devices for controlling the rotation of bobbins during winding thereon or therefrom." British Thomson-Houston Co., Ltd. (General Electric Co.). September 21st, 1921. (189,905.)
25,913. "Ignition magnetos for internal-combustion engines." E. A. Watson and M.-L. Magneto Syndicate, Ltd. September 30th, 1921. (189,918)
26,312. "Controlling device for automobile headlights." J. E. Gray. April 19th, 1921. (178,798.)
26,345. "Steel for making magnets." S. Watanabe. October 5th, 1921. (189,924.)
26,432. "Manufacture of silica glass." British Thomson-Houston Co., Ltd. (General Electric Co.). October 6th, 1921. (189,926.)
26,981. "Means for improving the current carrying capacity of existing three-phase alternating-current cable systems." A. M. Taylor. October 12th, 1921. (189,931.)
28,895. "Electric condensers." British Thomson-Houston Co., Ltd. (General Electric Co.). October 31st, 1921. (189,955.)
29,515. "Protective devices for electric circuits." J. S. Peck, G. E. Gittins, and Metropolitan-Vickers Electrical Co., Ltd. November 5th, 1921. (189,961.)
29,718. "Centrifugally-actuated electric switches for electric motors." W. Fairweather (Singer Manufacturing Co.). November 8th, 1921. (189,963.)
31,395. "Electrostatic telephones." J. Massolle, H. Vogt, and Dr. J. Engl. November 23rd, 1921. (189,982.)
31,490. "Selecting devices for automatic and semi-automatic telephone systems and circuits therefor." Siemens Bros. & Co., Ltd., and H. E. Humphries. November 24th, 1921. (189,984.)
31,756. "Ironclad electric switches." V. Hope. November 28th, 1921. (189,989.)
31,960. "Mercury and other vapour electric lamps." F. A. King, F. Reynolds, and Silica Syndicate, Ltd. November 29th, 1921. (189,993.)
32,930. "Electric incandescent lamps." E. Rohner and E. Simic. December 8th, 1921. (190,003.)
34,510. "Impulse transmitters of the dial type for telephone or like systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). December 22nd, 1921. (190,017.)

1922.

872. "Sparking plugs." W. Pickard. January 11th, 1922. (190,033.)
3,555. "Storage battery grid." A. E. Garrett, C. E. Funnell, and W. L. Hoffman. February 7th, 1922. (190,053.)
4,029. "Electric motor controlling switchgear." M. Solomon, C. C. Garrard, and W. Wilson. February 11th, 1922. (Addition to 165,626.) (190,057.)
8,368. "Electric glow discharge tubes." J. Massolle, Dr. J. Engl, and H. Vogt. March 24th, 1921. (177,590.)
8,374. "Sparking plugs." J. De La Boissiere. March 29th, 1921. (177,779.)
9,443. "Power transmission systems." Metropolitan-Vickers Electrical Co., Ltd. April 12th, 1921. (178,427.)
10,629. "Overload protective systems for electric motors." F. Krupp Akt. Ges. May 28th, 1921. (180,985.)
13,240. "Railway signalling." Saxby & Farmer (India), Ltd. May 12th, 1921. (179,945.)
24,889. "Sound-reflecting devices for talking-machines." Télégraphie Ges. System Stille. October 1st, 1921. (186,903.)
28,669. "Electrical cut-out." W. H. Illingworth. September 26th, 1921. (Divided application on 189,284.) (190,096.)

Phototelegraphy.—In the December 27th issue of the *Daily Mail* a specimen of a photograph that was transmitted a distance of 100 yards from one building and reproduced in another by means of radio-telegraphy was given. With this end in view the journal claims to have commenced experiments in 1908, and it is explained that the photograph is made to operate the transmitting apparatus in such a manner that the photographic image is reproduced faithfully on a sensitive film at the receiving station.